TM 10-1628

WAR DEPARTMENT TECHNICAL MANUAL

TRUCK, FORK LIFT

GASOLINE

(VAUGHAN-"TAW")

WAR DEPARTMENT · MARCH 1946

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. These instructions are published for the information and guidance of the personnel to whom this equipment is assigned. They contain information on the operation and maintenance of the vehicle and descriptions of the major units and their functions in relation to the other components of the vehicle. They apply only to the Truck, Fork Lift, Gasoline (Vaughan–"TAW"), and are arranged in four chapters. Chapter 1, Introduction; chapter 2, Operating Instructions; chapter 3, Maintenance Instructions; and chapter 5, Repair Instructions.

b. Technical Manuals and other publications applicable to the vehicle covered by this manual are listed in the reference section at the end of this manual.

2. Records

Using personnel will make use of the following maintenance forms and records in the performance of prescribed operations:

a. WD AGO Form 460 (Preventive Maintenance Roster). This form will be used to schedule and maintain a record of vehicle maintenance operations.

b. War Department Form 48 (Driver's Trip Ticket and Preventive Maintenance Service Record). This form, properly executed, will be furnished the operator when his vehicle is dispatched. The operator will complete in detail appropriate parts of this form. The reverse side of the form contains the operator's preventive maintenance service reminder schedule.

c. WD AGO Form 461 (Preventive Maintenance Service and Technical Inspection Work Sheet for Wheeled and Half-track Vehicles). This form will be used for all weekly and monthly maintenance services and all technical inspections.

d. WD AGO Form 468 (Unsatisfactory Equipment Report). This form will be used to report unsatisfactory conditions found in equipment.

e. WD AGO Form 478 (Modification Work Order). This form will be used whenever a modification is made on the vehicle.

3. Orientation

Throughout this manual the use of the terms "left," "right," and "front" must be understood to avoid confusion when following instructions. "Left" and "right" will be considered in relation to the operator standing on the platform ready to operate the vehicle. The fork lift carriage and mast assembly will be considered the "front" of the vehicle.

Section II. DESCRIPTION AND TABULATED DATA

4. Description

a. GENERAL. The truck, fork lift, covered in this manual is designed to hoist, handle, transport, tilt, and stack materials to desired height and position. The vehicle differs from the conventional type in that it is operated with the operator in a standing position. It is powered by a single cylinder, four-cycle, air-cooled, L-head gasoline engine. The vehicle is equipped with four clutches and gears, enclosed within a case, which perform the same duty as a transmission in a conventional vehicle. The two clutches on the right side of the case control the forward and backward movement of the vehicle. Those on the left side control the raising and lowering of the fork lift carriage and mast. Power is transmitted through the clutch mechanism and drive axle housing unit to the driving wheels. Power is also transmitted through the clutch mechanism and gear case unit by means of chains and sprockets for operation of the fork lift tilting carriage and mast assembly. Three levers mounted on the top right side of the control housing control the forward and backward movement of the vehicle as well as raising, lowering, and tilting of the fork lift carriage and mast. The steering hand wheel located on the top left side of the control housing controls the direc-

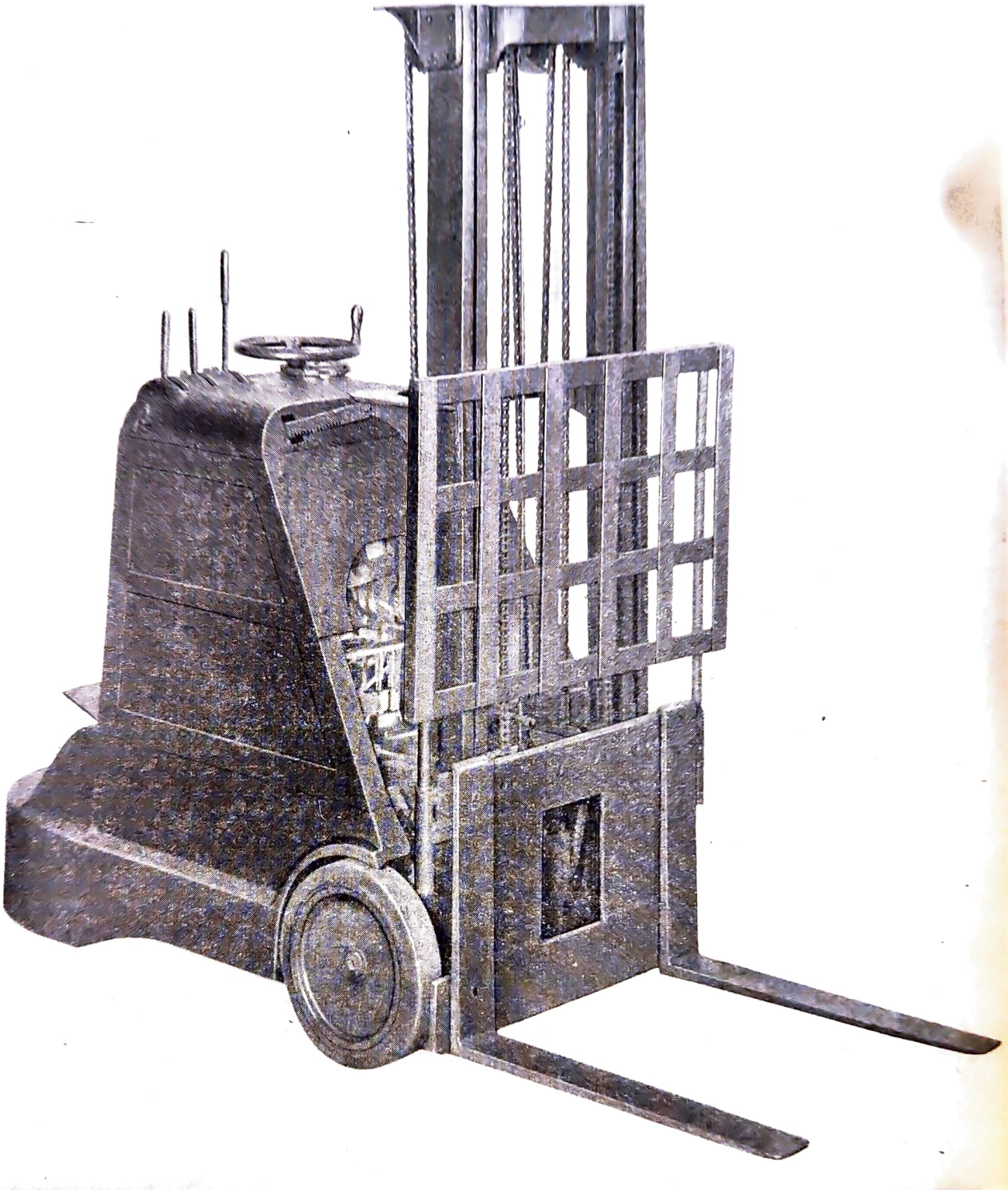


Figure 1. Right front ¾ view of vehicle.

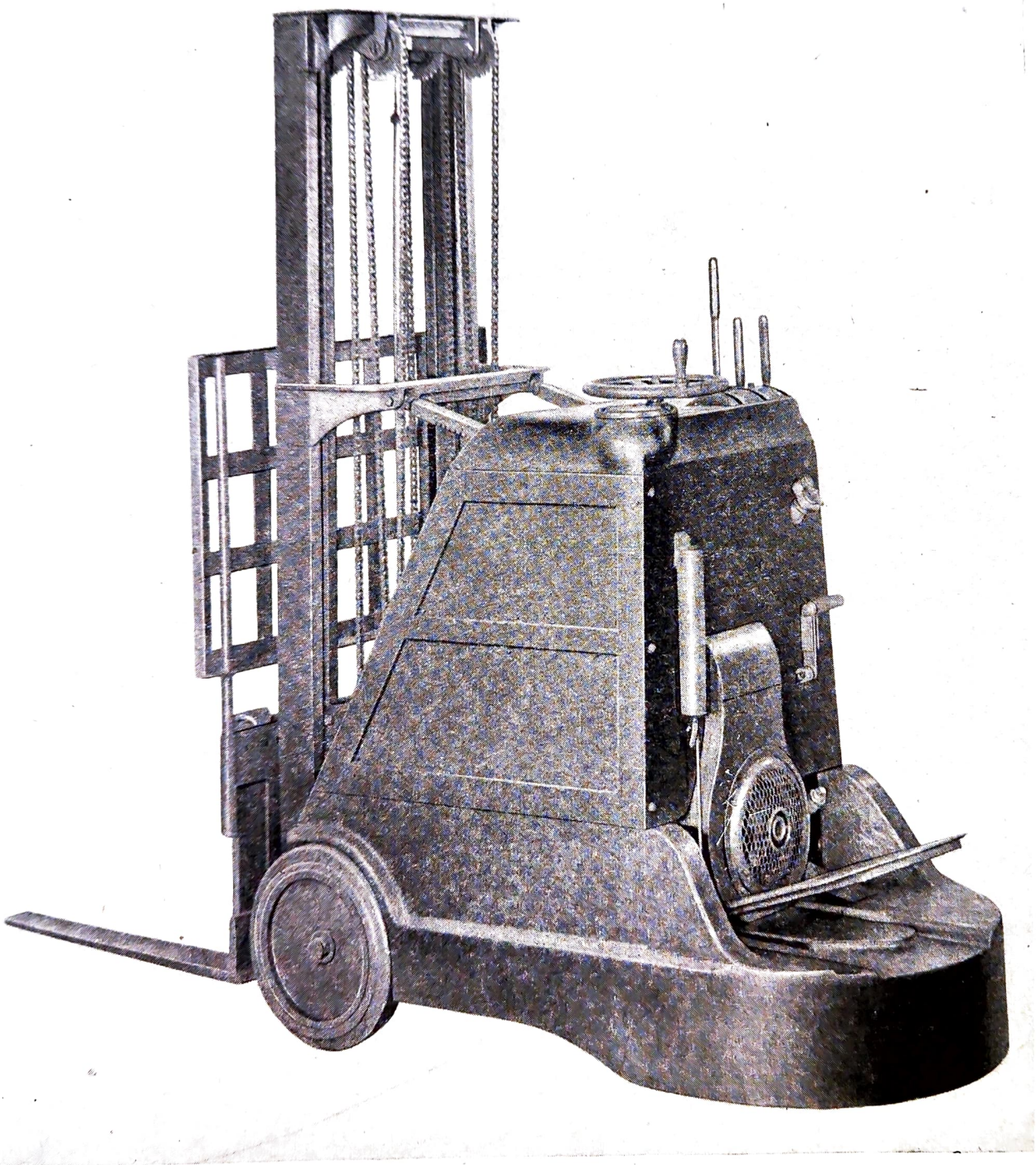


Figure 2. Left rear ¾ view of vehicle.

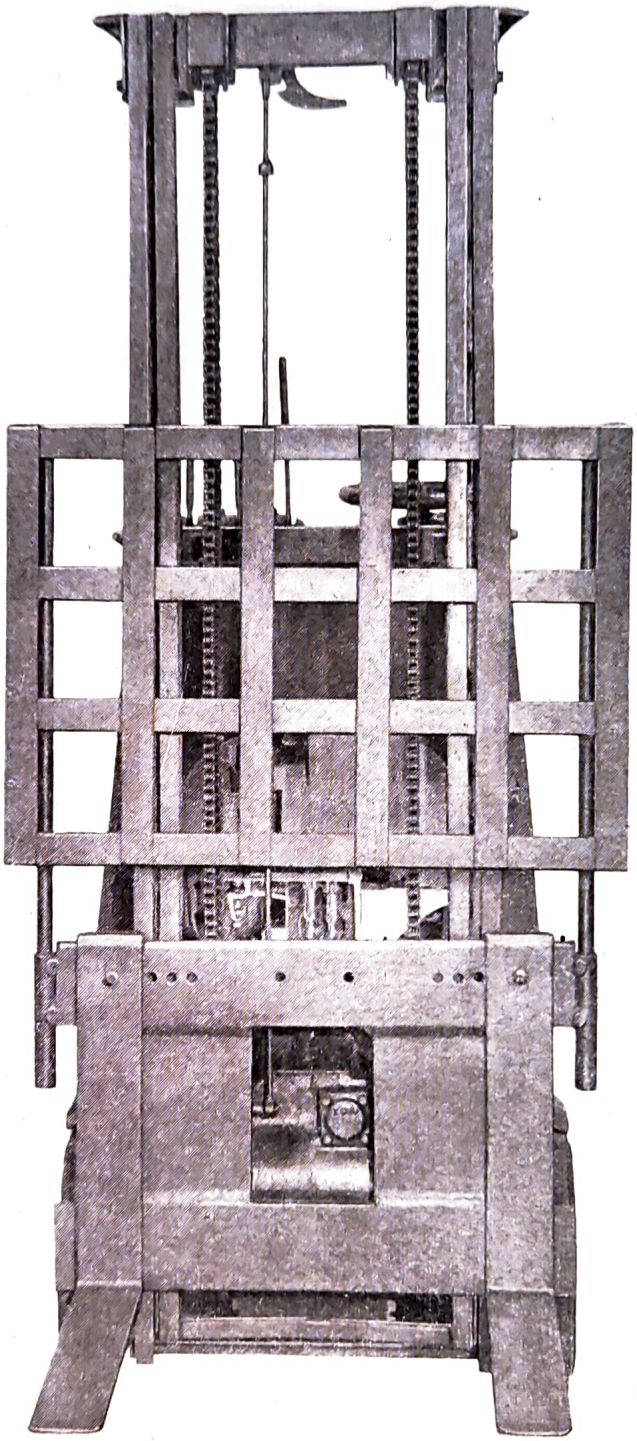


Figure 3. Front view of vehicle with carriage lowered.

tion of the vehicle by means of a chain connected between a sprocket at the base of the steering shaft and a sprocket secured to the steering wheel fork shaft.

b. Lift Mechanism. The lift mechanism is operated by engine power. The lift is controlled by means of a lift control lever located on the control housing in a quadrant situated to the operator's right. The load is lifted by two steel forks attached to a carriage plate which travels on steel masts. Engine power is transmitted to the carriage plate with its forks, by means of two clutches. One clutch is for lifting the load and the other clutch is for lowering the load. Engaging either clutch transmits engine power to a driving sprocket on which is a link chain. This chain passes over sprockets on the masts and the ends are secured to the carriage. The engine power therefore passes through either of the clutches to the chain and then to the carriage which carries the forks. Automatic stops prevent the load from being lifted too high or from being lowered so far as to hit the floor.

c. Tilt Mechanism. The load is tilted by engine power which is applied by a tilt control lever located on the control housing in a quadrant situated to the operator's right. The tilt mechanism consists of a power take-off at the engine which operates whenever the engine is being operated. This power take-off operates two friction wheels by means of a Vee belt. These friction wheels also rotate whenever the engine is being operated. The tilt control lever brings one or the other of these friction wheels into contact with a friction drum. The friction drum operates a chain which actuates a worm and two gears that are in constant mesh with two tilt racks. One end of both tilt racks is secured to the masts. The friction wheels and the friction drum act as a clutch so that if one of the wheels is in contact with the drum the gear operates on the tilt rack teeth and moves the mast to the rear. If the other friction wheel is in contact with the friction drum the tilt rack would move the mast to the front. Automatic stops on the control linkage prevent the load from being tilted too far forward or backward.

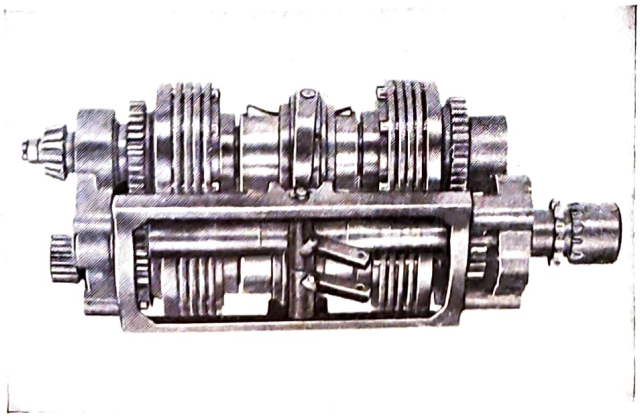


Figure 4. Clutch assembly.

d. Wheels. The two solid-tired driving wheels, keyed on tapered driving axle shafts, are gear driven through a bevel gear, intermediate gear, and a differential. The dual solid-tired wheel is the steering wheel.

e. Clutches (fig. 4). Gear shifting is eliminated by the use of four multiple disk clutches. The four clutches are located in a case bolted to the engine. Two of these clutches control the forward and re-

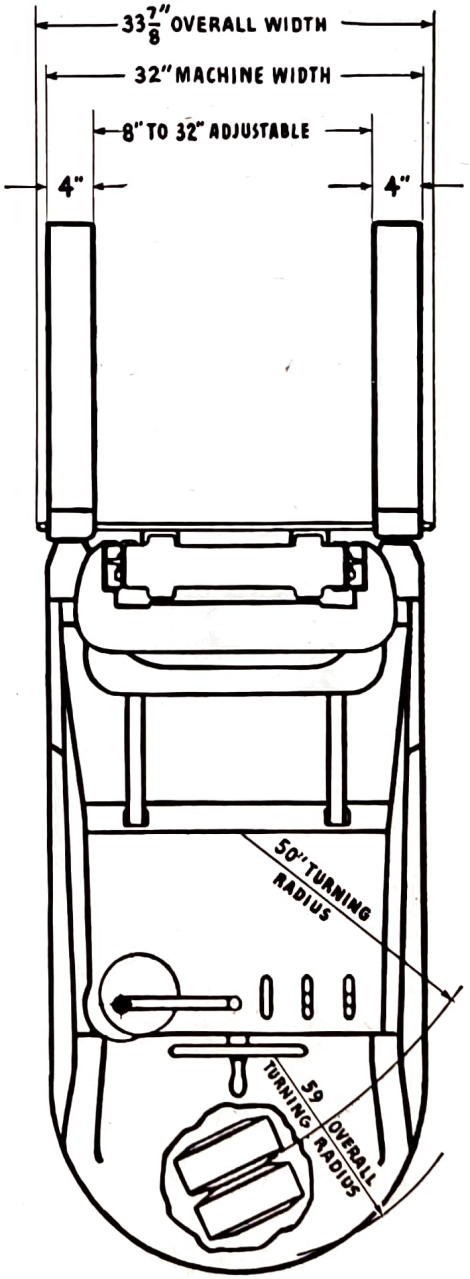


Figure 5. Width and turning radius chart.

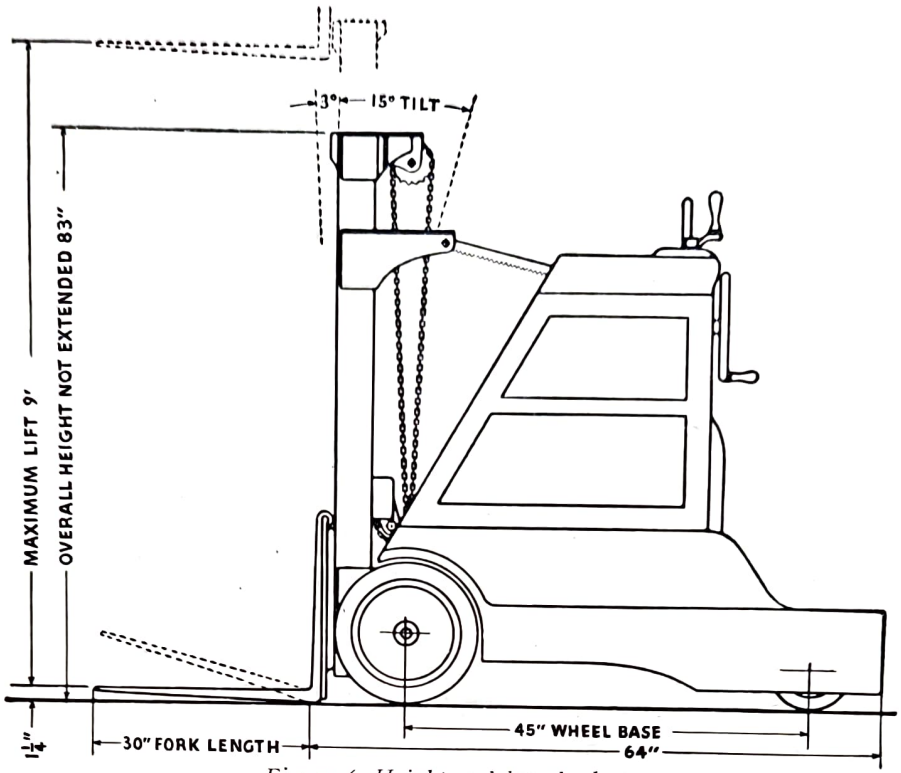


Figure 6. Height and length chart.

verse motion of the vehicle. The two remaining clutches control the lifting and lowering of the load carriage.

f. IDENTIFICATION. The vehicle identification is located in the center of the rear body panel in front of the operator.

5. Tabulated Data

a. VEHICLE SPECIFICATIONS.

Height overall, not extended	83 inches.
Length overall, excluding lift forks	64 inches.
Lift fork size:	
Standard fork	4 by 30 inches.
Special fork	4 by 36 inches.
Tires	Solid rubber.
Size	16 by 3½ x 12⅛ inches.
Tilt	15° back. 3° forward.
Weight	3,100 pounds.
Wheelbase	45 inches.
Wheel size:	
Front (Traction)	16 by 3½ inches.
Rear (Steering)	8½ by 4 inches, dual.
Turning radius, overall	59 inches.
Turning radius at steering wheel	50 inches.
Width:	
Over-all	33⅞ inches.
Of machine	32 inches.
Of lift forks	8 to 32 inches (adjustable).
Engine:	
Make	Vaughan.
Type	Air cooled.
Model	TAW.
Number of cylinders	1.
Bore	3¾ inches.
Horsepower	6.
Clutch:	
Make	Vaughan.
Model	TAW.
Quantity used	4.
Type	Disk in oil.
Gearcase:	
Make	Vaughan.
Model	TAW.
Carburetor:	
Make and model	Tillotson, YC4A.
Make and model	Stromberg, UR ¾.
Magneto:	
Make	Eisemann or Wico.
Type	Impulse coupling.
Steering gear:	
Make	Vaughan.
Type	Handwheel and chain.

Tilt mechanism:
- Make ..... Vaughan.
- Type ..... Rack and pinion.

Lift mechanism:
- Make ..... Vaughan.
- Type ..... Mechanical (chain).

Wheel size:
- Driving ..... 16 by 3½ inches.
- Steering ..... 8½ by 4 inches, dual.

b. Performance Data.

Speed of vehicle, forward or in reverse..... 4 miles per hour.

Speed of lift..... 25 feet per minute.

Lift, maximum..... 9 feet to underside.

Load capacity..... 2,000 pounds.

c. Capacities.

Gasoline ..... 3½ gallons.

Oil:
- Clutch case ..... 3 quarts.
- Drive axle housing..... 2 gallons.
- Tilt worm case..... ⅔ pint.
- Crankcase ..... 3 quarts.

Water in muffler..... 2 quarts.

Section III. EQUIPMENT

6. Vehicle Accessory

Item	*Number carried*	*Where carried*
Crank, starting	1	Right side of rear body panel.
Fire extinguisher	1	Right side of rear body panel.

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. GENERAL

7. Scope

This chapter contains information for the guidance of the personnel responsible for the operation of this vehicle. It contains information on the operation of the vehicle as well as description and location of the controls and instruments.

Section II. SERVICE UPON RECEIPT OF VEHICLE

8. Purpose

When a new or reconditioned vehicle is first received by the using organization, it is necessary for second echelon personnel to determine whether or not the vehicle will operate satisfactorily when placed in service. For this purpose, inspect all assemblies and equipment to see that they are in place and correctly adjusted. In addition, perform a run-in test of at least 2 hours as directed in AR 850–15, according to procedures in paragraph 10 of this manual.

9. Correction of Deficiencies

Deficiencies disclosed during the course of the run-in test will be treated as follows:

a. Correct any deficiencies within the scope of the maintenance echelon of the using organization before the vehicle is placed in operation.

b. Refer deficiencies beyond the scope of the maintenance echelon of the using organization to a higher echelon for correction.

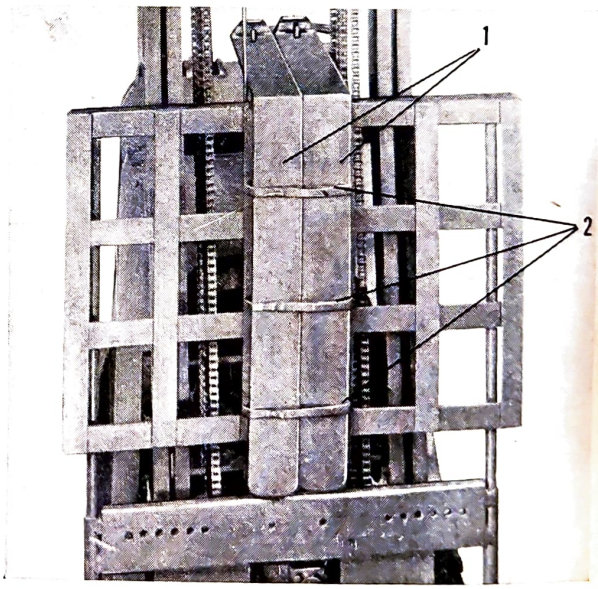
c. Bring deficiencies of serious nature to the attention of the supplying organization.

10. Run-in Test

a. PRELIMINARY SERVICES. (1) *Inspection for shipping damage.* Inspect vehicle for shipping damage such as dents in the body, broken chains, and bent or broken controls.

(2) *Starting crank.* See that the starting crank is in its proper place on right side of rear body panel. (See fig. 9.)

(3) *Lift forks.* Cut shipping straps (Fig. 7) and install each lift fork so that the hook on the upright of fork fits over the top of the carriage and the pin on the fork fits in one of the holes in the carriage. The distance between the forks is governed by carriage hole in which the fork pin is inserted. Adjust distance between forks to suit load to be lifted. (See fig. 3.)



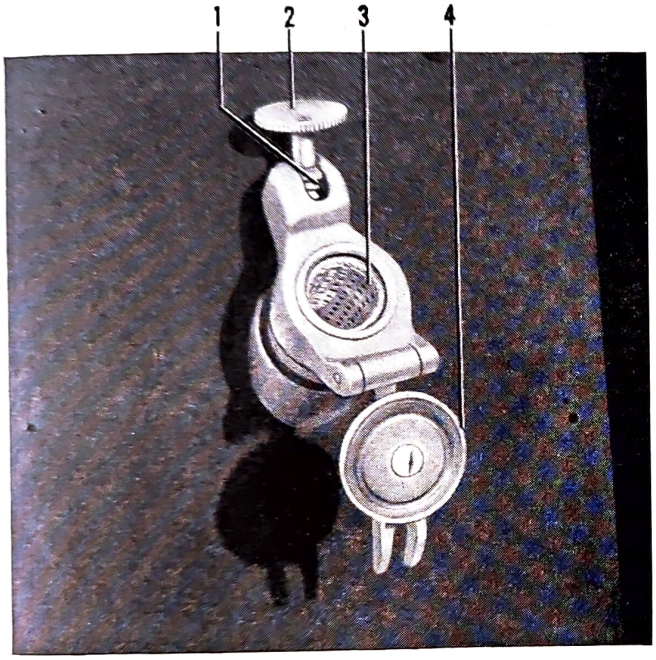
1. Lift forks. *2. Shipping straps.*

Figure 7. Front of vehicle showing forks in shipping position.

(4) *Engine.* Before starting a new engine, remove the spark plug and insert about a tablespoonful of engine oil into cylinder. Crank engine to distribute the oil over the cylinder walls; then reinstall plug.

(5) *Fire Extinguisher.* See that portable fire extinguisher is present, fully charged, and in good condition. Test it momentarily for proper operation, and mount it securely.

(6) *Fuel, oil, and water.* Fill fuel tank (capacity 3½ gals.). Inspect tank and fuel lines for leakage, and open fuel shut-off valve underneath sediment bowl. Inspect oil level in crankcase, tilt worm housing, gearcase, and clutch. See that muffler contains 2 quarts of water. Allow room for expansion in fuel tank. If there is a tag attached to filler concerning engine oil in crankcase, follow instructions on tag before operating vehicle.



1. *Filler cap knob spring.*
2. *Filler cap knob.*
3. *Filter screen.*
4. *Filler cap.*

Figure 8. Fuel tank filler cap.

(7) *Fuel filter.* Inspect fuel filter for good condition and for secure mountings and connections. Drain sediment bowl; if dirty, remove and clean bowl and filter element.

(8) *Assemblies, belts, and chains.* See that assemblies, such as carburetor, magneto, and air cleaner are in good condition and securely mounted. See that drive belt, tilt power take-off drive chain, and lift chains are in good condition and properly adjusted.

(9) *Electrical wiring.* See that electrical wiring is in good condition, securely connected, and properly insulated.

(10) *Tires.* See that all tires are in good condition. Remove objects lodged in the rubber treads and inspect for damage.

(11) *Wheel nuts.* See that all wheel mounting nuts are present and secure.

(12) *Lubricate.* Perform a complete lubrication of the vehicle covering all intervals according to the instructions on the War Department Lubrication Order. Omit any units covered in previous procedures.

(13) *Tilt mechanism.* Inspect all rods, connections, and linkage for looseness and damage. Perform all adjustments. Inspect automatic stops for proper operation.

(14) *Lift mechanism.* Inspect all rods and connections for looseness and damage. Perform all adjustments. Inspect automatic stops for proper operation.

(15) *Steering mechanism.* Inspect and, if necessary, adjust steering chain.

(16) *Choke.* Be sure choke opens and closes fully in response to operation of choke control.

(17) *Engine warm-up.* Start engine, noting any tendency toward hard starting.

(18) *Leaks, general.* Look in engine compartment and on ground under vehicle for fuel, or oil leaks. Inspect clutch and transmission case and drive axle housing for oil leaks.

b. RUN-IN TEST. Perform the following services during the run-in test of the vehicle.

(1) *Brakes.* With vehicle in motion release brake pedal and observe for smooth and effective braking. Vehicle should stop within reasonable distance, without side pull and without skidding.

(2) *Lift mechanism.* Operate the lift mechanism clutches. Clutch should operate smoothly; fork lift carriage should come to an automatic complete stop on both the upward and downward lift.

(3) *Tilt mechanism.* Operate the tilt mechanism. Mast assembly should tilt correctly and automatic stops should operate on both the back and forward tilt.

(4) *Motion control clutches.* Be sure that forward and reverse clutches operate smoothly and without drag.

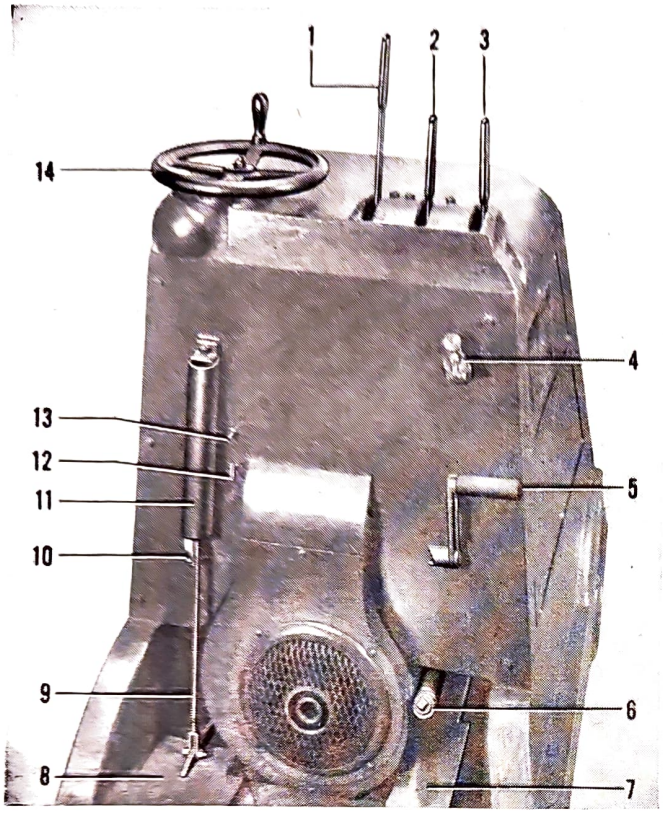
(5) *Steering.* Observe steering action for binding or looseness.

(6) *Engine.* Observe for backfiring, misfiring, and other abnormal engine operating characteristics, such as lack of power (or acceleration), stalling, overheating, or lack of response to controls.

(7) *Unusual noise.* Be alert throughout run-in test for any unusual noise from lift and tilt mechanisms, clutches, transmission case, drive axle or wheels that might indicate looseness, damage, wear, inadequate lubrication, or broken parts.

11. Used Equipment

Perform services in accordance with instructions in paragraph 10.



1. *Tilt control lever.*
2. *Lift control lever.*
3. *Motion control lever.*
4. *Gasoline tank filler cap.*
5. *Starting crank.*
6. *Engine oil filler plug.*
7. *Accelerator pedal.*
8. *Brake pedal.*
9. *Brake rod.*
10. *Brake hold-down catch.*
11. *Brake spring guide.*
12. *Choke control handle.*
13. *Ignition switch.*
14. *Steering hand wheel.*

Figure 9. Controls on rear of vehicle.

12. Controls (Fig. 9)

a. General. The vehicle controls include all operating levers, pedals and other controls located at the operator's platform. The operator stands on this platform to control the vehicle and the tilt or lift mechanisms.

b. Ignition Switch (fig. 9). The push-pull button type ignition switch is located on the left side of the rear body panel above the choke control handle. The switch button is pushed in to complete the ignition circuit between the magneto and the spark plug. The button is pulled out to break the circuit.

c. Choke Control Handle (fig. 9). The choke rod is used to operate the carburetor choke valve when starting a cold engine. The choke control handle is located on the left side of the rear body panel below the ignition switch. Pulling the choke control out closes the choke valve and provides a rich mixture to the engine cylinder. Releasing the choke control handle opens the choke valve and provides a normal operating mixture to the engine cylinder.

d. Brake Pedal (fig. 9). This vehicle is equipped with a deadman brake. The brake pedal, located on the left of the operator's platform, provides a means of releasing the brake. The normal position of the pedal is up; in this position the brakes are applied. Depress the pedal to release the brake.

e. Accelerator Pedal (fig. 9). The accelerator pedal is located on the right side of the operator's platform and controls the speed of the engine. Depress the pedal to increase engine speed. Release pedal to decrease engine speed.

f. Motion Control Lever (fig. 9). The motion control lever, the right most of the three levers located on top of the control housing, is used to apply engine power to the driving wheels. This lever engages one clutch to provide forward motion of the vehicle and another similar clutch to provide backward motion of the vehicle. Push lever forward for forward motion and pull lever back for reverse motion as indicated by letters "F" and "R." (See fig. 13.) Lever is in neutral when it is midway between forward and reverse positions.

g. Tilt Control Lever (fig. 9). The tilt control lever, the left most of the three levers located on top of the control housing, is used to apply engine power to the tilt mechanism. Push lever forward for forward tilt and pull lever back for backward tilt as indicated by letters "A" and "B." (See fig. 13.) Lever is in neutral when it is midway between letters "A" and "B."

h. Lift Control Lever (fig. 9). The lift control lever, the center lever of the three levers located on top of the control housing, is used to apply engine power to the fork lift carriage. Push lever forward to lower fork lift carriage and pull lever back to raise fork lift carriage as indicated by letters "D" and "U." (See fig. 13.) Lever is in neutral when it is midway between letters "D" and "U."

i. Steering Hand Wheel (fig. 9). The steering hand wheel, located on left side of top of control housing, controls the direction of the vehicle.

j. Starting Crank (fig. 9). The hand starting crank, used to start the engine, is carried on the lower right side of the rear body panel.

k. Back Rest (fig. 3). A back rest in front of the masts prevents the load from falling backward

when the mast is tilted.

l. Brake Pedal Hold-Down Catch (fig. 9). This catch, located below the brake spring guide on the lower left side of the rear body panel is used to secure the brake pedal in a released position. Step on brake pedal and place catch against bottom of brake spring guide.

13. Instruments

No instruments are used on this vehicle.

Section IV. OPERATION UNDER USUAL CONDITIONS

14. Vehicle Operation

a. General. Before starting the vehicle perform the before operation service given in paragraph 23.

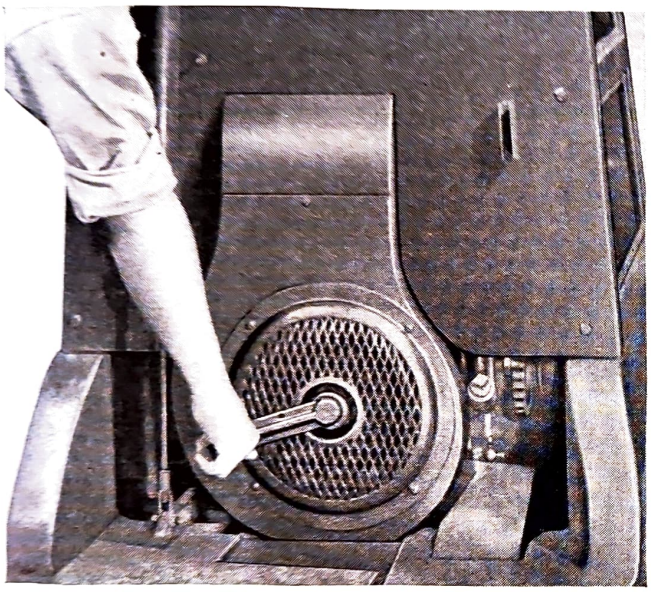


Figure 10. Cranking the engine.

b. Starting Engine. (1) Be sure that the tilt control, motion control, and lifting control levers are in an upright (neutral) position.

(2) Step on brake pedal to release the brakes and apply the brake pedal hold-down catch so that the pedal will be held in its released position.

(3) Push the ignition switch button in.

(4) Remove the starting crank from its holder and insert it into the engine flywheel so that the jaw engages the end of the engine crankshaft. Grasp the handle with the thumb back of the handle and pull up *slowly,* standing as shown in figure 10. Do not spin or turn the crank completely around. The vehicle is equipped with an impulse starter, a normal steady pull could start the engine. If the engine is cold, pull out the choke control handle for one turn of the starting crank and choke on the intake or suction stroke.

Note. If the engine does not start after five or six attempts refer to paragraph 27 on engine trouble shooting. Determine and remedy the cause.

(5) Operate the engine for 3 or 4 minutes at fast idle in order to warm it to operating temperature.

c. Placing Vehicle In Motion. (1) The operator's position on the vehicle depends upon the direction in which it is to be driven. When moving forward, the operator stands so that his body is parallel to the face of the machine. (See fig. 11.) When traveling backward, the operator places his right hip against the truck so that his body is at an angle of about 30°. (See fig. 12.)

(2) Mount the vehicle and stand with the left foot on the brake pedal and the right foot on the accelerator pedal.

Note. When the brake pedal is depressed the brake pedal hold-down catch should automatically release; if it does not, release the catch manually.

(3) Move the lift control lever to "D" to lower or to "U" to elevate the fork lift carriage until the lift forks are from 2 to 4 inches from the ground. Accelerate the engine slightly.

(4) Move the tilt control lever to "B" to tilt the mast assembly backward.

(5) Move the motion control lever to "F" to move the vehicle forward; move the lever to "R" to move backward.

Note. For increased visibility and safe operation, travel in reverse whenever possible, especially when transporting a load.

Caution: Never operate the vehicle at top speed.

d. Stopping Vehicle. (1) Release the brake pedal to check the speed of or stop the vehicle. This applies the brakes on the driving wheels.

(2) Never operate motion control lever to use clutch as a brake.

(3) Set motion control lever in "neutral" *after* vehicle is stopped.

e. Stopping Engine. Move the ignition switch button outward as far as it will go.

f. Loading Vehicle. (1) Move the vehicle to where the load is to be picked up and then raise or lower the lift forks to the level necessary to pick up the load.

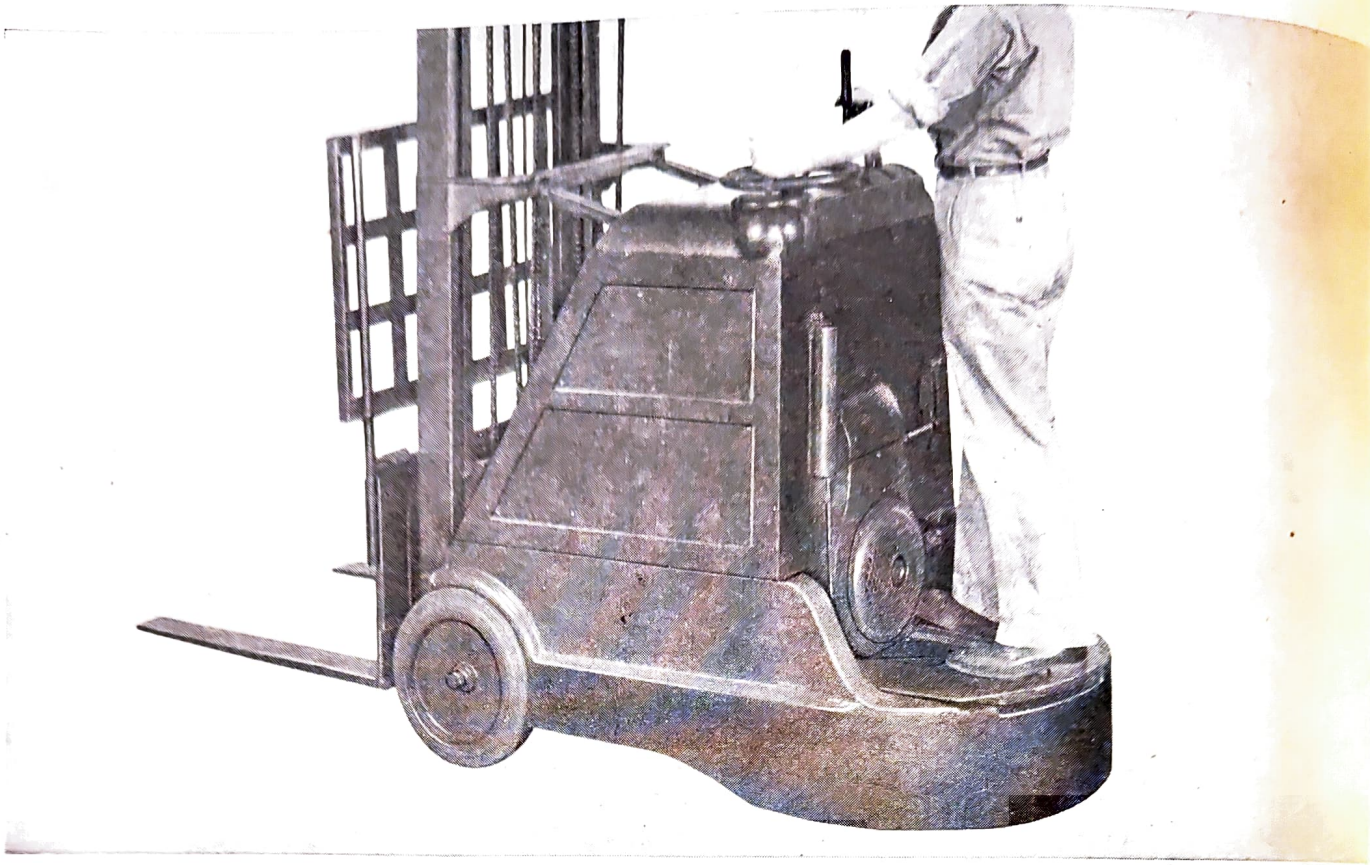
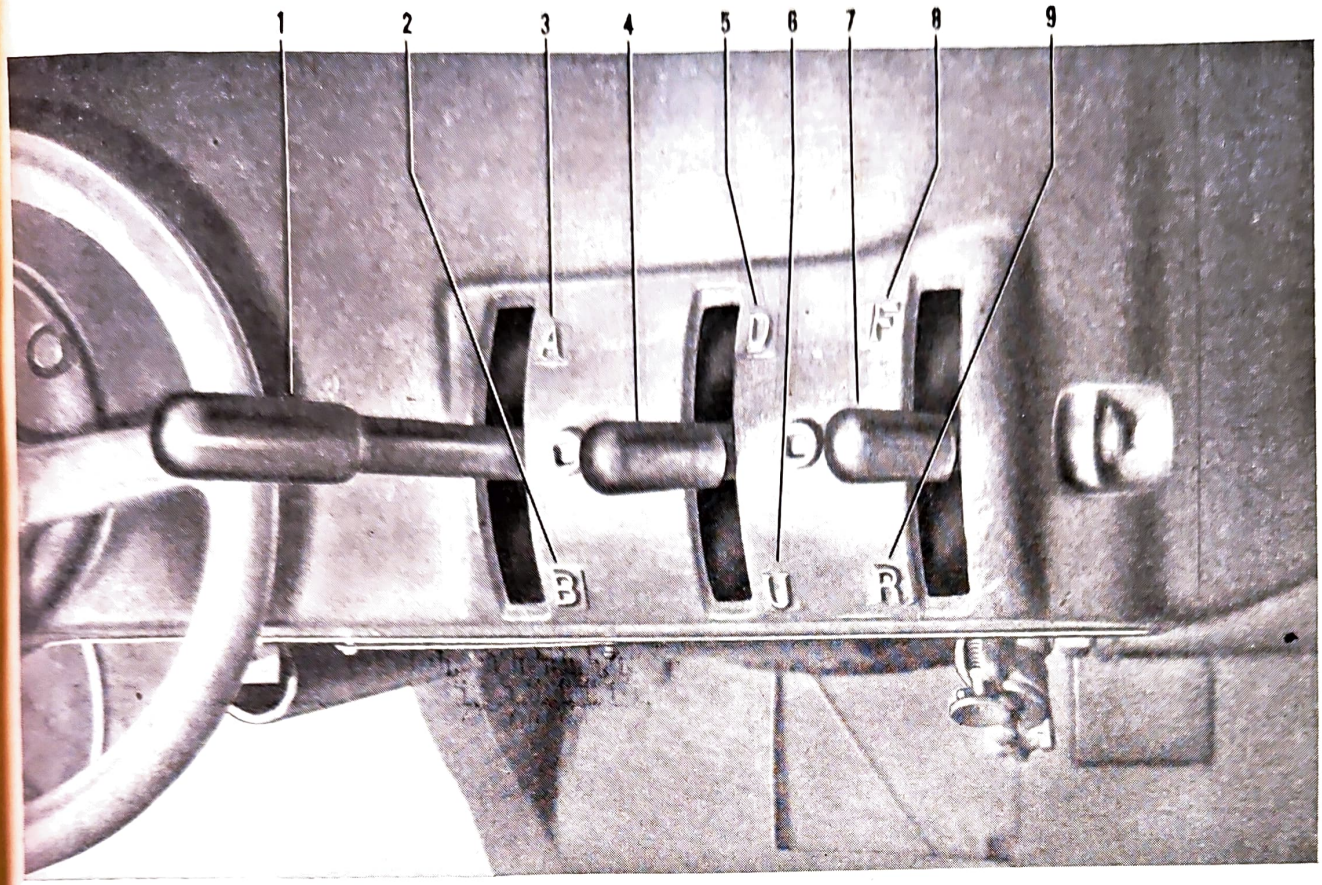


Figure 11. Operator's position driving forward.

Figure 12. Operator's position driving in reverse.



1. *Tilt control lever.*
2. *"Back" position.*
3. *"Ahead" position.*
4. *Lift control lever.*
5. *"Down" position.*
6. *"Up" position.*
7. *Motion control lever.*
8. *"Forward" position.*
9. *"Reverse" position.*

Figure 13. Control quadrant and levers.

Note. Approach the load from the front and square with the load.

(2) Move the tilt control lever to "A" position and move the vehicle so that the lift forks are in the pallet or under the load. The load should fit as close to the carriage heel as possible.

(3) Raise the load by moving lift control lever to "U," then move the tilt control lever to "B" to tilt the load backward.

g. Operating Loaded Vehicle. (1) Travel with the load 2 to 4 inches from the ground. Do not raise, lower or tilt the load while traveling.

(2) Never allow a load to descend by gravity; serious damage to chains may result. Lower fork lift carriage by moving the lift control lever forward; this permits the automatic stop to check the descent. If the carriage descends of its own weight, the carriage shoes will drift to the cross member stop, causing a sudden stop and the chain drive sprocket will tend to coast and take up all the tension of the tension spring. If this happens, raise the carriage about 1 inch before tilting the mast assembly to prevent the chain from jumping a sprocket or breaking below the lift sprocket.

h. Depositing Load. (1) Move lift control lever to bring load to required level for unloading.

(2) Place the load and then move the tilt control lever forward to free forks.

Section V. OPERATION UNDER UNUSUAL CONDITIONS

15. Extreme Heat

a. Operation. Avoid unnecessary idling of the engine. Remove the four side body plates to assist in cooling the engine.

b. Lubrication. Lubricate the engine, clutches, and drive axle housing in accordance with War Department Lubrication Order for hot weather lubrication. Frequently inspect the amount of lubri-

cant in these units and replenish if necessary.

c. MUFFLER. Keep muffler filled with 2 quarts of water.

d. ADJUSTMENTS. Keep tilt and lift mechanism in proper adjustment. (See pars. 73 to 75.)

16. Extreme Cold

a. FUEL. Use a winter grade of gasoline to reduce starting difficulties. Keep the gasoline tank full to avoid accumulation of condensation.

b. LUBRICATION. Follow instructions on War Department Lubrication Order and in paragraph 20.

c. ELECTRICAL SYSTEM. Inspect and clean the magneto breaker points. Inspect, clean, and tighten all connections. Clean, adjust, or replace the spark plug. Test the timing.

d. FUEL SYSTEM. Remove and clean the sediment bowl and filter element daily. Adjust the carburetor to a richer fuel mixture.

e. BRAKES. Brake bands, particularly on new vehicles, tend to bind when they are cold. Park the vehicle with the brake released to prevent seizing. Block the wheels to prevent movement of the vehicle.

f. OPERATION. Start the engine and maintain the engine speed at a fast idle for 5 minutes. Operate the lift mechanism and if it does not operate freely lubricate in accordance with instructions on War Department Lubrication Order. Repeat this procedure with the tilt mechanism. If steering gear mechanism binds or is hard to operate, inspect adjustment and lubricate in accordance with instructions on War Department Lubrication Order.

g. MUFFLER. Drain water from muffler when temperature reaches 32° F.

17. Special Conditions

The vehicle is designed to operate on hard surfaces only; because of its ground clearance and wheel size, it will not operate on loose dirt, sand, cinders, gravel, or mud.

Section VI. DEMOLITION TO PREVENT ENEMY USE

18. Methods and Tools

a. Using an axe or sledge, break the magneto, carburetor, engine, and clutch. Remove the wheels and destroy the wiring and chains.

b. Break the glass sediment bowl and ignite the gasoline.

c. Destroy identical parts on all similar vehicle to prevent enemy use by salvage or cannibalization.

CHAPTER 3

MAINTENANCE INSTRUCTIONS

Section I. GENERAL

19. Scope

This chapter contains information for the guidance of the personnel of the using organizations responsible for the maintenance (first and second echelon) of this vehicle. It contains information needed for the performance of the scheduled lubrication and preventive maintenance services as well as descriptions of the major systems and units and their functions in relation to other components of the vehicle.

Section II. LUBRICATION

20. Lubrication Order

a. WDLO 6004 (fig. 14) prescribes first and second echelon lubrication.

b. A War Department Lubrication Order is placed on this vehicle and is to remain on it at all times. If the vehicle is received without a War Department lubrication order, the using organization should immediately requisition a copy in conformance with instructions and lists in FM 21–6.

c. Instructions on the War Department Lubrication Order are binding on all echelons of maintenance and there shall be no deviations.

d. Lubrication intervals specified on the War Department Lubrication Order are for normal operating conditions. Reduce these operating hour intervals during high or low temperatures, periods of high speed, operation in sand or dust, immersion in water, or exposure to moisture, any one of which may quickly destroy the protective qualities of the lubricant and require immediate lubrication to prevent damage or failure.

e. Lubricants are prescribed in the "KEY" on the War Department Lubrication Order in accordance with three temperature ranges, "above +32° F.," + "32° F. to 0° F." and "below 0° F.". The time to change grades of lubricants is determined by maintaining close observation on operation of the vehicle during the approach to change-over periods. Sluggish starting may be an indication that lubricants are thickening and a warning to change to grades prescribed for the next lower temperature. Change grades of lubricants *only when air temperatures are consistently in the next higher or lower range.*

21. Detailed Lubrication Instructions

a. LUBRICATION EQUIPMENT. Each vehicle is supplied with lubrication equipment adequate for its lubrication. Clean before and after use. Operate lubricating guns carefully to assure a proper application of the lubricant.

b. POINTS OF APPLICATION. Lubrication fittings, grease cups, oilers, and oil holes may be located by reference to the War Department Lubrication Order. Clean them and the surrounding surfaces before applying lubricant.

c. CLEANING AND WASHING. Use solvent, dry cleaning, or oil, fuel, Diesel, to clean or wash all parts. Use of gasoline for this purpose is prohibited. After cleaning, dry all parts thoroughly before applying lubricant.

d. COLD WEATHER LUBRICATION (0°F. TO 65°F.) (1) *General.* Operation of this vehicle at subzero temperatures presents problems that require special precautions. Careful lubrication by maintenance personnel is required if damage or failure is to be avoided.

(2) *Keeping crankcase oil fluid.* Give preference to the following in the order listed:

(*a*) Store the vehicle in a heated enclosure.

(*b*) When the engine is stopped, drain the oil while hot and store in a warm place until the vehicle is to be operated. If warm storage is not available, heat the oil before reusing.

Note. Heat only to a temperature at which the bare hand can be immersed without being burned. Attach a tag to the steering hand-wheel containing a warning to personnel that the crankcase is empty.

(*c*) *Crankcase oil will be diluted with engine fuel.*

Use the following procedure to provide properly diluted oil for cold starting. Below 0°F., replenish with 2¼ quarts of OE. Add ¾ quart of engine fuel to bring oil level to test cock. Operate engine 5 minutes to mix oil and fuel. Maintain level by adding engine fuel. Drain crankcase at each shut-down period of 5 hours or more and refill as prescribed above.

(*d*) The presence of a large percentage of light dilutent will increase oil consumption and, for that reason, the oil level should be inspected frequently.

e. INDIVIDUAL LUBRICATION NOTES. The following instructions supplement the notes on the War Department Lubrication Order:

(1) *Steering wheel bearings.* At specified intervals, remove wheel from steering fork, wash bearings, axle, and inside of hub; and dry thoroughly. *Do not use compressed air.* Inspect bearings and replace if damaged. Lubricate bearings and pack the reservoir between the inner and outer bearings of each wheel about two-thirds full with WB grease. Protect the bearings from dirt and immediately reinstall bearings and wheel.

(2) *Magneto cam oil pad (Wico only).* Semi-annually remove pad and squeeze and work into it some CO. Then oil magneto in accordance with instructions on WDLO 6004.

f. REPORTS AND RECORDS. (1) Report unsatisfactory performance of equipment and lubricants on WD AGO Form 468 (Unsatisfactory Equipment Report), in accordance with instructions on the form.

(2) A record of lubrication may be maintained in the WD AGO Form 460 (Preventive Maintenance Roster).

No. 6004

WAR DEPARTMENT LUBRICATION ORDER

WAR DEPARTMENT WASHINGTON 25, D. C., 22 JUNE 1944

TRUCK, FORK LIFT

MOBILIFT MODEL TAW (GAS)

(VAUGHAN MOTOR COMPANY)

For detailed instructions refer to TM 10-1678

Clean fittings before lubricating. Lubricate after washing.

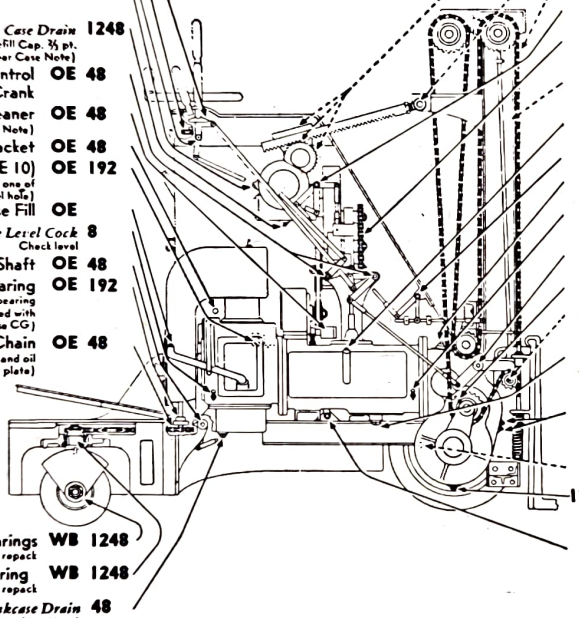
Clean parts with SOLVENT, dry-cleaning or OIL, fuel, Diesel. Dry before lubricating.

Requisition replacement Lubrication Orders from the Warehouse Equipment Parts Division, Columbus ASF Depot, Columbus, Ohio.

Reduce intervals under severe operating conditions.

Lubricate dotted arrow points on both sides.

Figure		Lubricant	Operating Hours
15	Control Handle Segments Coat segments	CG	48
16	Steering Gear Case Remove plate, keep oil level with top of gear	GO	192
15	Control Levers	OE	48
17	Tilt Worm Case Check level	GO	48
17	*Tilt Worm Case Drain* Drain and refill Cap. 3½ pt. (See Gear Case Note)		1248
18	Motion and Lift Control Bell Crank	OE	48
19	Air Cleaner Wash and recoil (See Note)	OE	48
20	Foot Accelerator Bracket	OE	48
21	Magneto (SAE 10) (Some models, remove one of 2 plugs, fill to plug level hole)	OE	192
22	Crankcase Fill	OE	
23	*Crankcase Level Cock* Check level		8
24	Brake Pedal Shaft	OE	48
25	Steering Shaft Bearing Raise collar to expose bearing (On models equipped with fitting use CG)	OE	192
26	Steering Chain Wash and oil (Remove floor plate)	OE	48
27	Steering Wheel Bearings Remove, clean and repack	WB	1248
	Steering Fork Bearing Remove, clean and repack	WB	1248
28	*Crankcase Drain* Drain and refill Cap. 3 qt. (See Note)		48



Operating Hours	Lubricant		Figure
48	OE	Tilt Control Rack and Gear Clean and oil	29
48	OE	Tilting Bracket Pin	30
48	OE	Lift Chain Clean and oil	31
48	OE	Tilt Control Bell Crank	32
48	OE	Power Tilt Drive Chain Clean and oil	32
48	CG	Carriage Channels Clean and coat	33
	OE	Clutch Housing Fill	34
48	OE	Tilt Stop Bell Crank	35
	GO	Gear Case Fill	36
8		*Clutch Housing Level Cock* Check level	34
48	OE	Lift Stop Bell Crank	
48	CG	Mast Support Bearing	37-38
48	CG	Carriage Idler Sprocket Elevate lift to reach	39
48		*Clutch Housing Drain* Drain and refill Cap. 3 qt. (See Gear Case Note)	28
8		*Gear Case Level Cocks* Keep lubricant level between level cocks. Check level	36
48	OE	Brake Shoe Crank	40
1248		*Gear Case Drain* Drain and refill Cap. 8 qt. (See Note)	
48	OE	Brake Bell Crank	42

KEY

LUBRICANTS	LOWEST ANTICIPATED AIR TEMPERATURE			LUBRICANTS
OE—OIL, engine	above +32°F.	+32°F. to 0°F.	below 0°F.	**WB**—GREASE, general purpose, No. 2
Crankcase	SAE 30	SAE 10	See Note	
Clutch Housing	SAE 30	SAE 10	SAE 10	
Other Points	SAE 30	SAE 10	PS	
GO—LUBRICANT, gear, universal	SAE 90	SAE 80	Grade 75	**PS**—OIL, lubricating, preservative, special
CG—GREASE, general purpose	No. 1	No. 0	No. 0	

NOTES

AIR CLEANER—Remove filter element, wash thoroughly, dry and oil with used crankcase oil or OE.

CRANKCASE—Drain only when hot. Refill to prescribed level. If equipped with magnetic drain plugs, clean before replacing. Below 0°F. replenish with 2¼ qt. of OE SAE 10. Add ¾ qt. motor fuel to bring oil level to test cock. Run engine 5 minutes to thoroughly mix oil and fuel. Maintain level by adding motor fuel. Drain crankcase at each shut down period of 5 hours or more and refill as prescribed above.

GEAR CASES—Drain only when hot. Fill to prescribed level. If equipped with magnetic drain plugs, clean before replacing.

OIL CAN POINTS—Every 48 hours, lubricate clevises, pins, steering wheel handle, and other small moving parts with OE.

DO NOT LUBRICATE—Intermediate Bearing Housing, Sprocket Bearings, Drive Wheel Bearings, Magneto (some models).

Copy of this Lubrication Order will remain with the equipment at all times; instructions contained therein are mandatory and supersede all conflicting lubrication instructions dated prior to 22 June 1944.

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

No. 6004 [NOT TO BE REPRODUCED in whole or in part without permission of the Office of The Quartermaster General]

Figure 14 — Lubrication order.

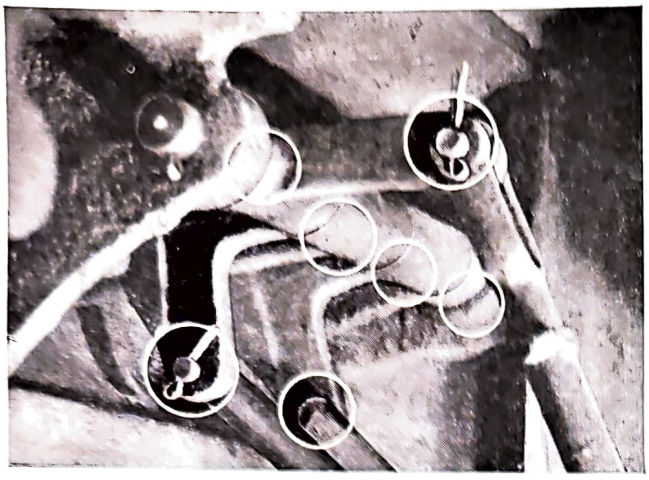


Figure 15. Control lever linkage and connections.

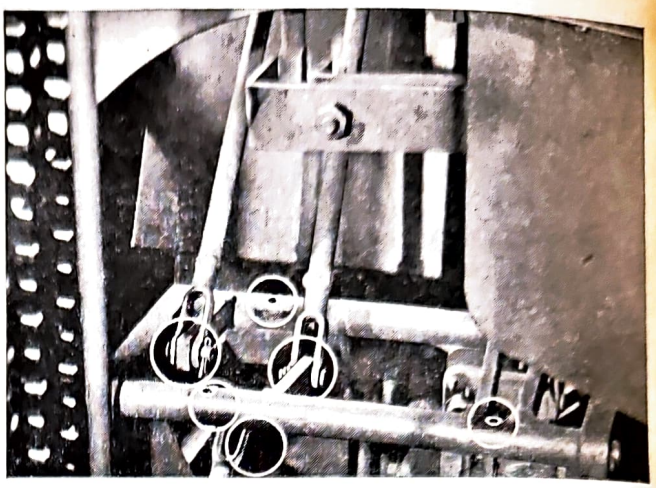


Figure 18. Motion and lift control bell crank.

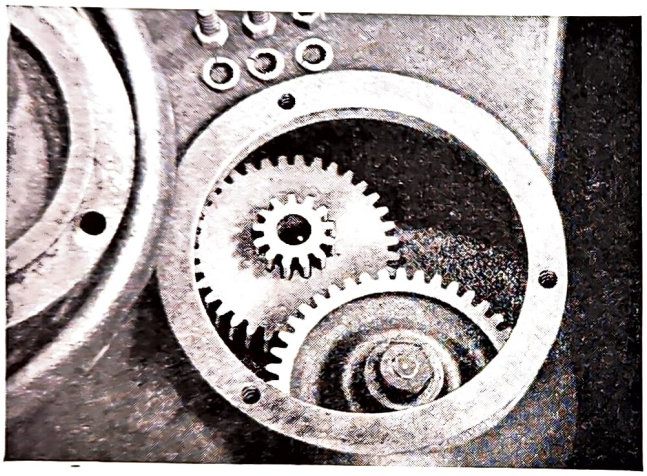


Figure 16. Steering gear case.

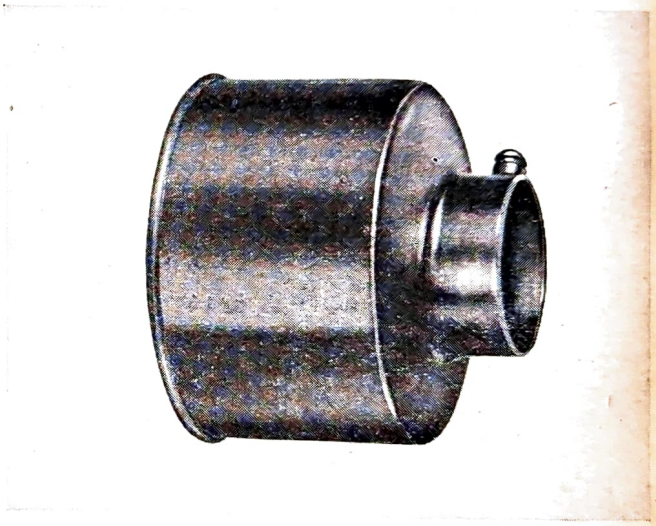


Figure 19. Air cleaner.

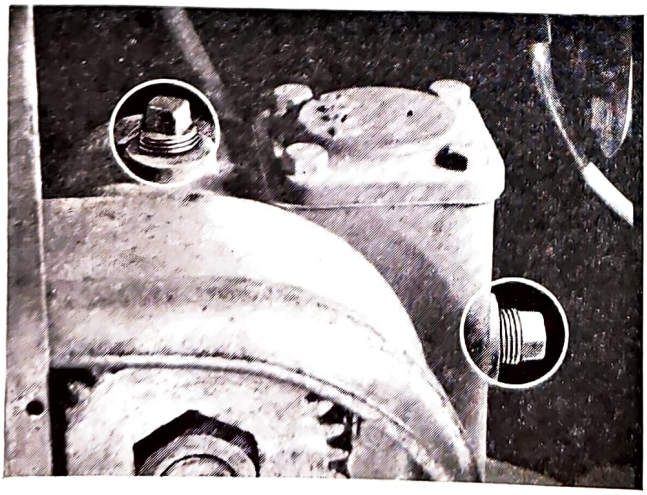


Figure 17. Tilt worm case filler and drain plugs.

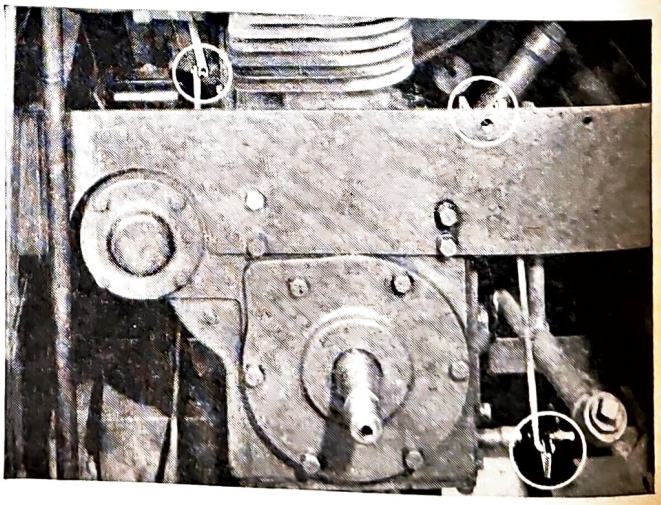


Figure 20. Accelerator pedal bracket.

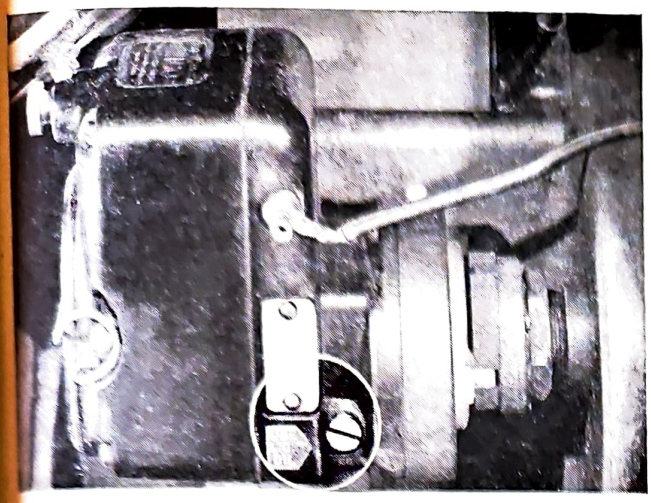


Figure 21. Magneto.

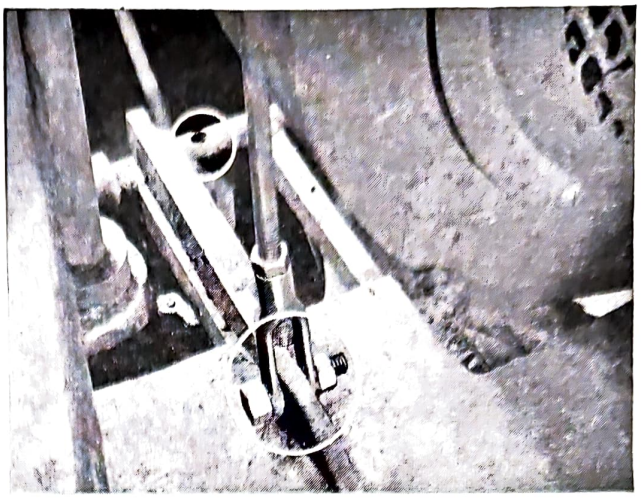


Figure 24. Brake pedal shaft and brake rod clevis.

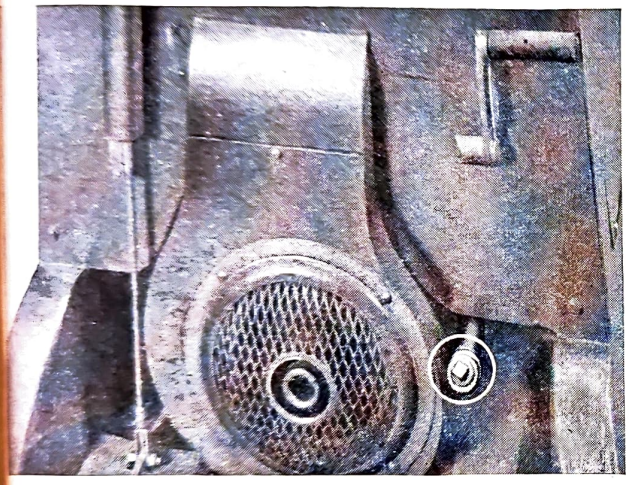


Figure 22. Engine crankcase oil filler.

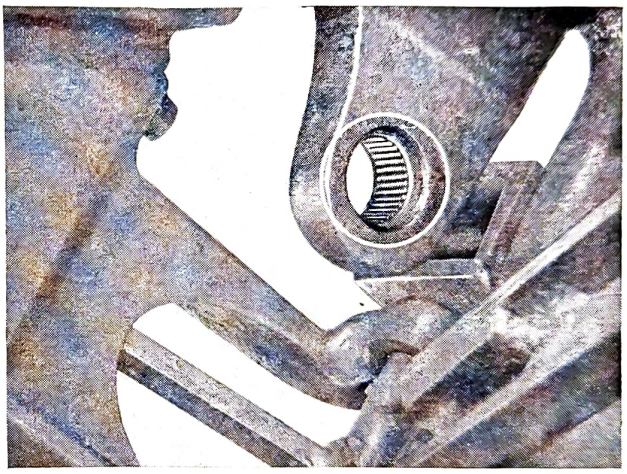


Figure 25. Steering shaft needle bearing.

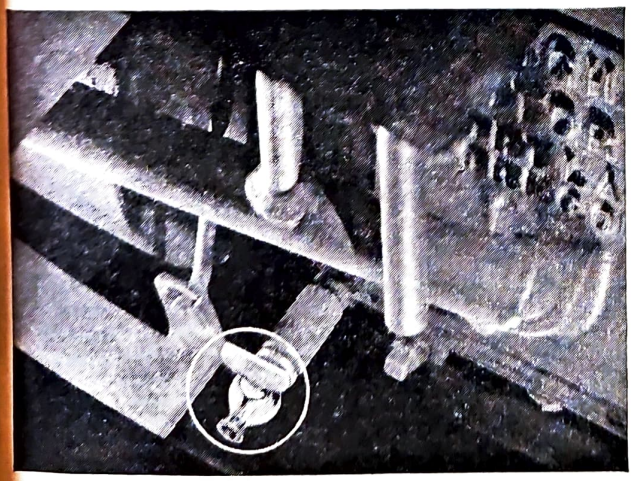


Figure 23. Crankcase oil level cock.

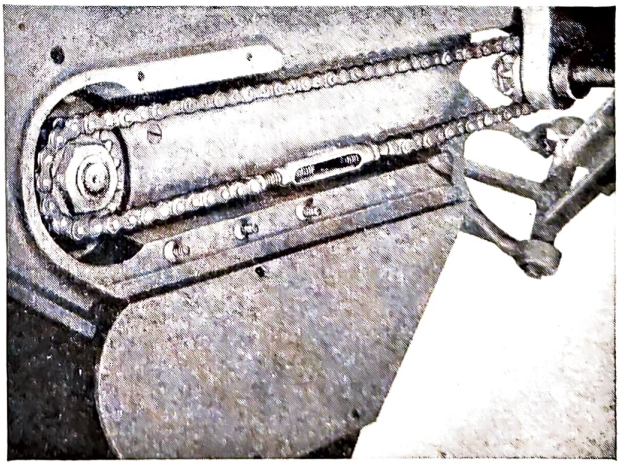


Figure 26. Steering chain.

Figure 27. Steering wheel bearings.

Figure 30. Tilt bracket pin.

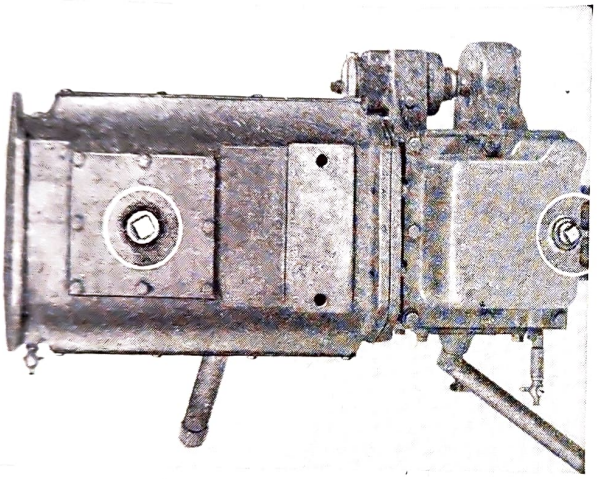


Figure 28. Crankcase and clutch case drain plugs.

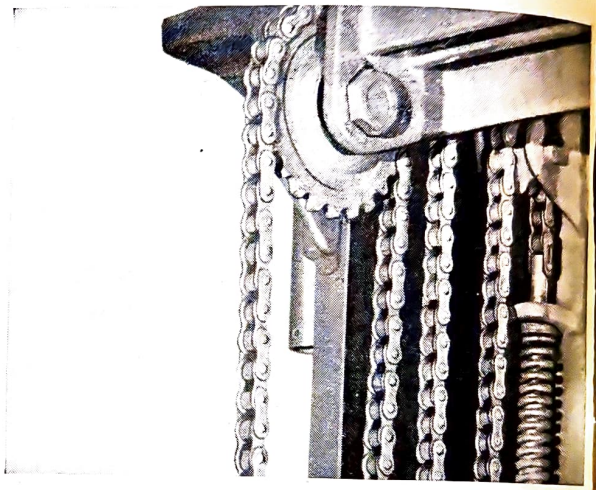


Figure 31. Lift chain.

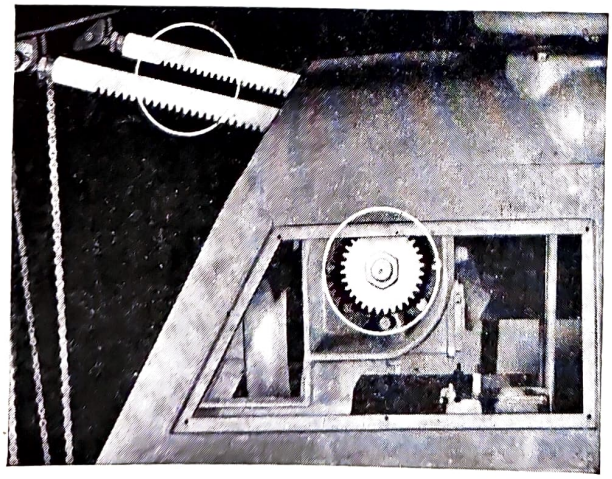


Figure 29. Tilt control rack and gear.

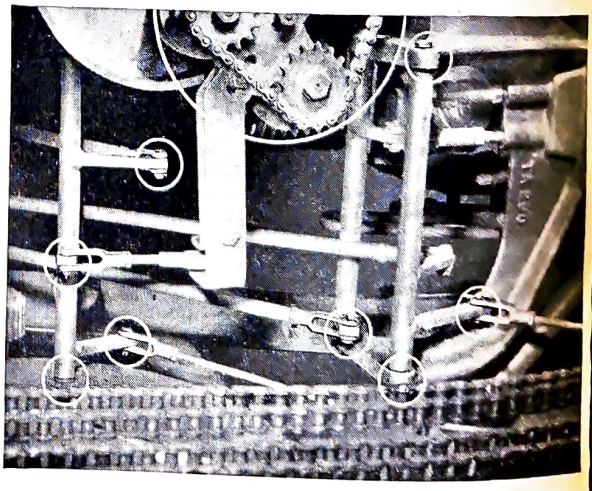


Figure 32. Tilt control bell crank and power tilt drive chain.

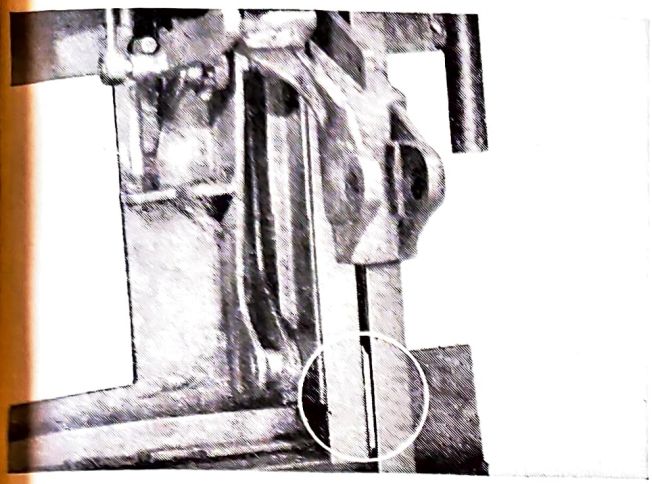


Figure 33. Carriage channels.

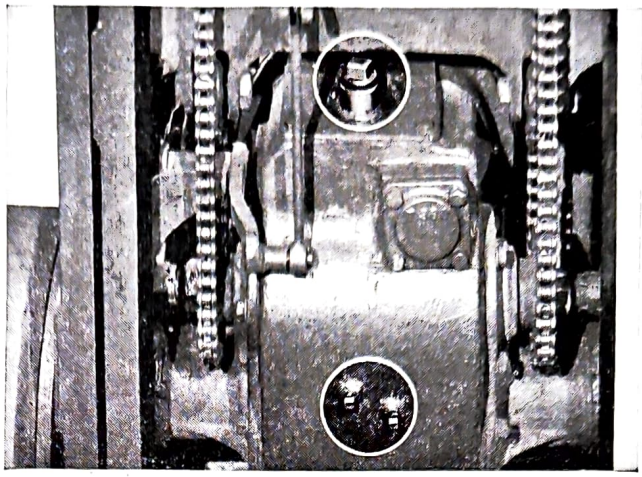


Figure 36. Drive axle housing filler and level plugs.

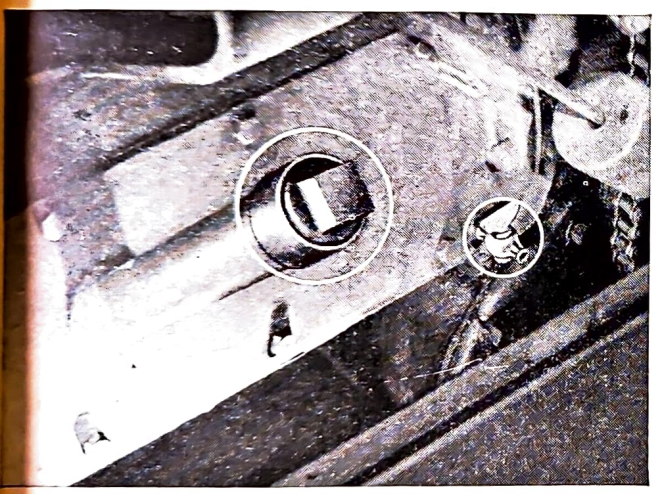


Figure 34. Clutch case fill and level cock.

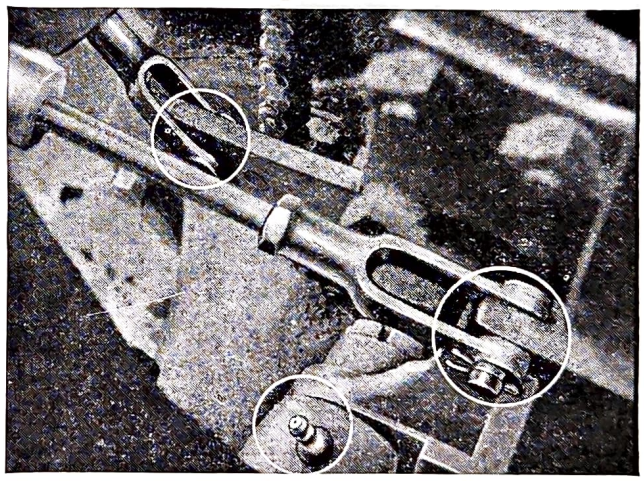


Figure 37. Mast support bearing and control rods.

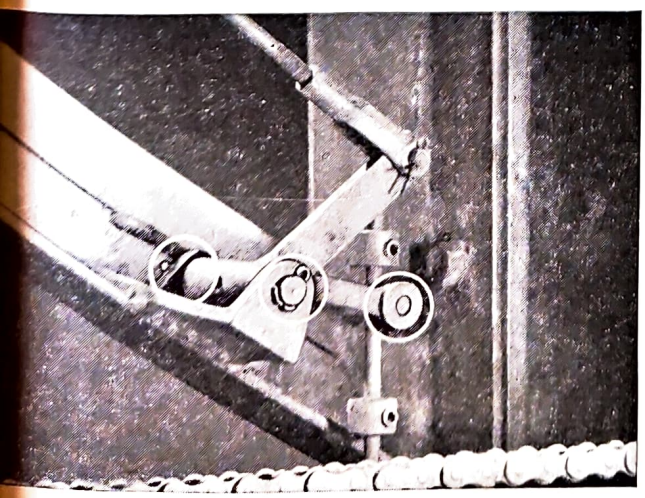


Figure 35. Tilt stop bell crank.

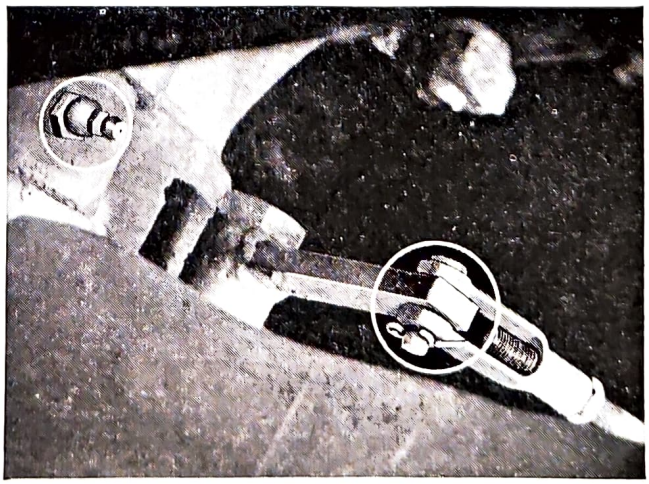


Figure 38. Mast support bearing and brake rods.

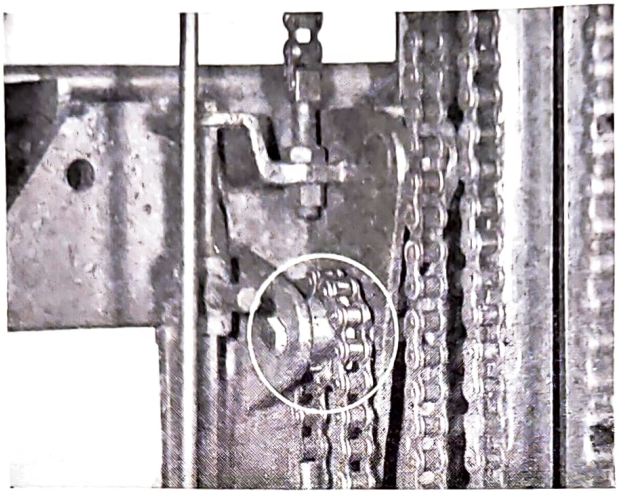


Figure 39. Carriage idler sprocket.

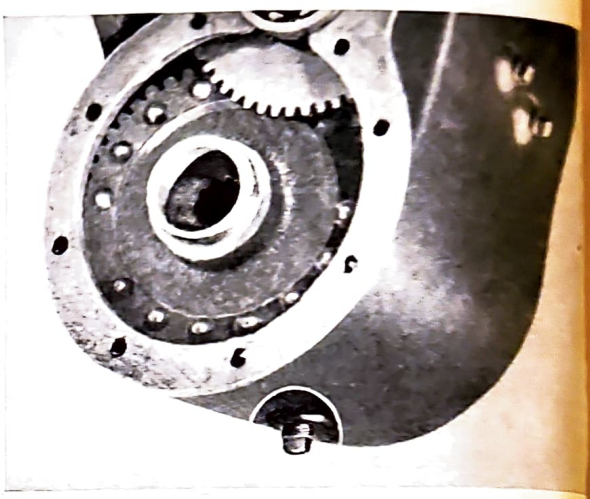


Figure 41. Drive axle housing drain plug.

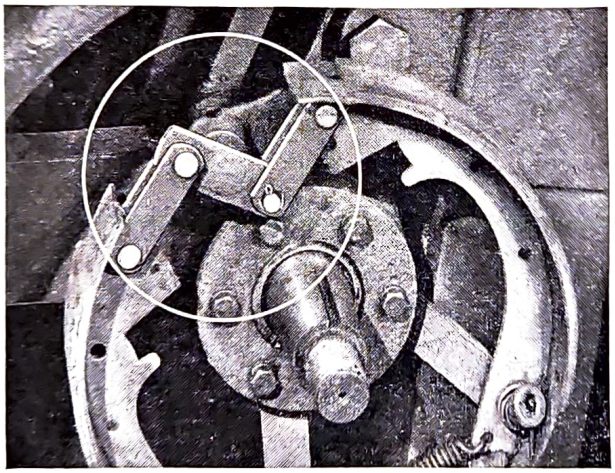


Figure 40. Brake shoe crank.

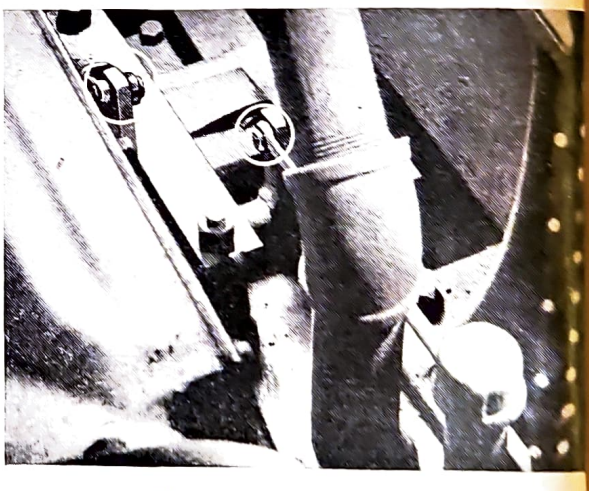


Figure 42. Brake bell crank.

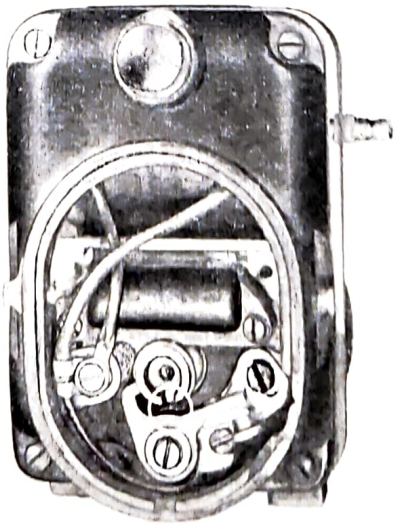


Figure 43. Magneto cam oil pad (Wico only).

Section III. PREVENTIVE MAINTENANCE SERVICE

22. Scope and Description

a. Preventive maintenance services are a function of the using organization maintenance personnel.

b. To insure mechanical efficiency, it is necessary that the vehicle be systematically inspected at intervals each day it is operated, and each week, so that defects may be discovered and corrected before they result in damage or failure. Certain scheduled maintenance services will be performed at those designated intervals. The services set forth in this section are those performed by operator before operation and during operation, by maintenance mechanic after operation, and by second echelon organizational maintenance personnel at weekly and monthly intervals.

c. Operator preventive maintenance services are listed on the back of War Department Form 48 (Driver's Trip Ticket and Preventive Maintenance Service Record) to cover vehicles of all types and models. Items peculiar to this vehicle, but not listed on War Department Form 48, are covered under related items. Certain items listed on the form that do not pertain to this vehicle are eliminated from the procedures as written into this manual. Every organization must thoroughly school each operator in performing the maintenance procedures set forth in this manual, whether or not they are listed specifically on War Department Form 48.

d. The items listed on War Department Form 48 that apply to this vehicle are expended to provide specific procedures for accomplishment of the inspection and services. These services are arranged to facilitate inspection and conserve the time of the operator, and are not necessarily in the same numerical order as shown on War Department Form 48. The item numbers, however, are identical with those shown on that form.

e. The general inspection of each item applies to any supporting member or connection, and includes an inspection to see that the item is in good condition, correctly assembled, secure, and not worn.

(1) *Good condition.* An inspection to determine that the unit is not damaged beyond safe or serviceable limits, and is not bent, twisted, chafed, burned, broken, cracked, bare, frayed, dented, collapsed, torn, or cut.

(2) *Correctly assembled.* An inspection to see that the unit is in its correctly assembled position in the vehicle.

(3) *Secure.* A hand feel, wrench, or prybar inspection for looseness, including brackets, lock washers, lock nuts, locking wires, or cotter pins used in assembly.

(4) *Worn.* Worn close to or beyond serviceable limits, and likely to result in damage or failure if not replaced.

f. Any defects or unsatisfactory operating characteristics beyond the scope of the first echelon to correct must be reported at the earliest opportunity to the designated individual in authority.

23. Before-operation Service

a. GENERAL. This is primarily an inspection to see that the vehicle has not been tampered with or sabotaged since the after-operation service was performed. It is the duty of the operator to determine whether or not the vehicle is in condition to carry out the mission to which it is assigned.

b. PROCEDURES. Before-operation service consists of inspecting items listed below according to the procedure described, and reporting any deficiencies. Upon completion of the service, results should be reported promptly to the designated individual in authority.

(1) *Item 1. Tampering and damage.* Inspect the exterior of vehicle, engine, fan housing, subassemblies, wheels, brakes, steering, tilt and lift control mechanism for tampering and damage. Dry the ignition parts if wet, to assure easy starting. Be sure starting crank is present and in good condition.

(2) *Item 2. Fire extinguisher.* Be sure that fire extinguisher is full and securely mounted, and that nozzle is clean.

(3) *Item 3. Fuel, oil, and water.* Inspect fuel tank, crankcase, clutch, tilt worm and drive axle housing, fan housing, and muffler for leaks or tampering. Add fuel or oil as required. Fill muffler with 2 quarts of water.

(4) *Item 4. Assemblies.* Inspect carburetor, magneto, air cleaner, fuel tank, cap, lines and filter, lift and tilt assemblies, fan housing and flywheel, muffler, magneto, and ignition system for good condition, tight connections, and secure mounting.

(5) *Item 6. Leaks, general.* Look within engine compartment and beneath vehicle for fuel, oil, or water leaks. Trace leaks to source and report to designated individual in authority.

(6) *Item 7. Engine warm-up.* Start engine; be

alert for unusual noises. Idle engine only fast enough to operate smoothly. Proceed immediately with the following services while engine is warming up.

(7) *Item 8. Choke.* As engine warms up, open choke as required to assure smooth operation and to prevent oil dilution.

(8) *Item 13. Wheels and flange nuts.* See that wheel mountings and axle nuts are present, tight, and in good condition.

(9) *Item 14. Tires.* See that rubber has not separated from rims, that tires are not cut, torn, or otherwise damaged, and that treads are free from flat spots. Remove embedded objects from treads.

(10) *Item 16. Steering mechanism.* Inspect steering mechanism for good condition, proper adjustment, correct and secure assembly.

(11) *Item 17. Counterweight.* Inspect counterweights for good condition and secure mounting

(12) *Item 19. Body.* Inspect side frames, side panels, rear and front panels, control panel hood, carriage lift mast assemblies and supports, fan housing, and grille for good condition and correct secure assembly.

(13) *Item 22. Engine operation.* Accelerate and decelerate engine. Observe for misfiring, backfiring, or unusual noises indicating compression or exhaust leaks, worn, damaged, or loose parts, or inadequate lubrication. Report deficiencies to designated individual in authority.

(14) *Item 23. (WD AGO Form 9–74) (Operator's Permit).* Operator must have operator's permit on his person. See that WDLO 6004 is present, legible, and properly applied.

(15) *Item 25. During-operation service.* Begin the during-operation service immediately after vehicle is put in motion.

24. During-operation Service

a. General. While vehicle is in motion, listen for rattles, knocks, squeaks, or hums indicating trouble. Look for indications of trouble in air cooling system and for smoke from any part of the vehicle. Be alert to detect odor of overheated components or subassemblies such as magneto, brakes, clutch, power tilt take-off, and friction drive units; observe for fuel vapor from a leak in fuel system, exhaust gas, or other signs of trouble. Test operation of vehicle by operating clutch in forward and backward direction, frequently applying brakes and turning vehicle in both directions; operate lift and tilt mechanisms and observe for unsatisfactory or unusual performance.

b. Procedures. During-operation service consists of observing items listed below according to the procedures following each item, and investigating indications of serious trouble. Notice deficiencies to be reported at earliest opportunity.

(1) *Item 27. Brakes.* Test frequently. Brakes must stop vehicle smoothly and effectively, within reasonable distance, without side pull, chatter, or squeak. Stop vehicle on reasonable grade, with brake pedal in fully released position. Brakes must hold vehicle securely, with reserve spring tension.

(2) *Item 28. Clutch and power tilt mechanism.* The clutch and power tilt mechanism is the medium of vehicle operation; it is actuated through push-pull lever control.

(*a*) Test clutch operation by moving motion control lever in forward and reverse positions. Move lift control lever to its raising and lowering positions; see that automatic stops function correctly.

(*b*) Test tilt operation actuated through power tilt mechanism by moving tilt control lever in both directions; see that automatic stops function correctly.

(*c*) Each operating lever must have 1-inch free travel at end of lever from neutral position (straight up) on control housing, in backward and forward direction, before meeting resistance, and must return freely to neutral position upon release.

(*d*) Clutch and power tilt mechanism must operate smoothly in each position, without chatter, grab, or slipping.

(*e*) With vehicle stationary on level ground, engine operating, tilt and lift controls in neutral positions, and brakes released, observe for creeping of any individual operating unit. Creeping indicates dragging clutch or tilt friction drives, which must be adjusted. **Caution:** Do not use clutch levers to slow down or stop vehicle; use brakes.

(3) *Item 31. Engine and control.* Be alert for deficiencies in engine performance such as lack of power, misfiring, unusual noises, stalling, overheating, or unusual exhaust smoke. Notice whether or not engine responds satisfactorily to control.

(4) *Item 33. Steering Mechanism.* Observe steering for side pull, wander, shimmy, hard steering, or unusual noises indicating loose, worn, or binding parts.

(5) *Item 34. Running gear.* Listen for unusual noises from wheels, drive axle housing, and axles.

(6) *Item 35. Body, lift, and tilt mechanism.* Be alert for unusual noises indicating loose counter-

weight bumper, side panels and frame, fan housing, carriage, mast assembly, or tilt mechanism.

(7) *Item 37–1 Materials handling equipment.* Listen for unusual noises. The hoist and tilt mechanism should operate satisfactorily, without creeping, and there should be no lag or binding in any part of the mechanism. Observe control levers and linkage for correct adjustment. Report deficiencies to the designated individual authority.

25. After-operation Service

a. PURPOSE. After-operation service is particularly important because at this time the maintenance mechanic inspects the vehicle to detect and correct deficiencies. Report results of inspection promptly to the designated individual in authority. If this schedule is performed thoroughly, the vehicle should be ready to operate again on short notice. The before-operation service, with a few exceptions, is then necessary only to ascertain whether the vehicle is in the same condition in which it was left upon completion of the after-operation service.

b. PROCEDURES. When performing the after-operation service, the mechanic must correct any irregularities noted on War Department Form 48 during the day in the before-operation and during-operation services. The after-operation service consists of inspecting and servicing the following items.

(1) *Item 54. Fuel, oil, and water.* Fill fuel tank. Inspect lubricant levels in crackcase, clutch and tilt worm housing, and drive axle housing; add lubricant as required. Fill muffler with 2 quarts of water; see that water float gauge operates.

(2) *Item 55. Engine Operations.* Listen for misfiring, backfiring, noise, or vibration indicating worn parts, loose mountings, inadequate lubrication, incorrect fuel mixture, or defective ignition.

(3) *Item 60. Fire extinguisher.* Test for proper operation. Be sure that fire extinguisher is full, and securely mounted and that nozzle is clean.

(4) *Item 63. Assemblies and belt.* Inspect all assemblies, such as carburetor, magneto, fan housing and flywheel, fuel tank, filler cap and line, muffler and connections, for good condition, tight connections, proper alignment, and secure mounting. Inspect tilt power take-off belt and chain for good condition. Test for finger deflection which should be zero.

(5) *Item 64. Electrical wiring.* Inspect ignition cable and magneto ground wire for good condition, tight and correct connections, proper insulation, secure support, and clearance from hot metal surfaces and vehicle parts. Replace defective wiring.

(6) *Item 65. Air cleaner and breather tube.*

(*a*) *Air cleaner.* Inspect air cleaner and connecting parts for good condition, secure mounting, correct and tight connections. Inspect element for cleanliness; clean if required and oil element as prescribed in WDLO 6004.

(*b*) *Crankcase breather.* See that breather tube is in good condition, clean, and securely attached.

(7) *Item 66. Fuel filter and carburetor.* Inspect fuel filter, carburetor, shut-off valve, lines, and connections for good condition, secure mounting; see that glass sediment bowl is not cracked or broken; clean bowl and filter element as required.

(8) *Item 67. Engine controls.* Inspect for worn or disconnected linkage, correct, and secure assembly.

(9) *Item 68. Tires.* See that rubber has not separated from rims, that tires are not cut, torn, or otherwise damaged, and that treads are free from flat spots. Remove embedded objects from treads. Replace worn or otherwise unserviceable tires.

(10) *Item 70. Steering mechanism.* Inspect steering mechanism for good condition, correct adjustment, and secure assembly.

(11) *Item 73. Leaks, general.* Look within engine compartment and beneath vehicle for fuel, oil, or water leaks. Trace leaks to source and correct.

(12) *Item 74. Gear lubricant levels.* After units have cooled, inspect lubricant levels in crankcase, clutch, tilt worm, and drive axle housing for correct levels. Fill as required with lubricant prescribed in WDLO 6004.

(13) *Item 76. Counterweights.* Inspect counterweights for good condition and secure mounting. Tighten loose mounting and assembly bolts and nuts.

(14) *Item 78. Body and frame.* Inspect chassis frame and supports, engine mount, frame, panels, and control housing for good condition, correct alignment, and secure assembly. Examine vehicle paint for blisters and rust spots. See that vehicle markings, identification plates, clutch adjustment plate, and WDLO 6004 are present, securely attached, and legible.

Note. If frames, supports, or braces are distorted, misaligned, or damaged, report condition to designated individual in authority.

(15) *Item 82. Tighten.* Tighten vehicle assembly and mounting bolts, nuts, locking devices, and screws which a thorough inspection indicates require tightening.

(16) *Item 83. Lubricate as needed.* Lubricate points indicated on WDLO 6004 as requiring attention, and points that experience and operating conditions indicate need lubrication. Observe latest lubrication directives.

(17) *Item 84. Clean engine and vehicle.* (*a*) Clean dirt and grease from engine compartment, exterior of engine, power tilt drive, carrier, masts, and chains.

(*b*) Weekly, wash vehicle. Wipe off thoroughly; clean engine.

(18) *Item 85. Starting crank.* Be sure engine starting crank is present, in serviceable condition, and securely mounted in holder on right side of rear body panel.

(19) *Item 87. Materials handling equipment.* Inspect lift and tilt mechanisms for good condition and secure assembly. Inspect lift chains for proper adjustment, the connecting link for serviceability and the locking device for security. Inspect control levers and linkage for correct adjustment and good condition. Inspect for lubricant leaks and inadequate lubrication.

26. Second Echelon Preventive Maintenance Service

Regular scheduled maintenance inspections and services are a preventive maintenance function of the using organization and are the responsibility of commanders of operating organizations.

a. FREQUENCY. The frequency of the preventive maintenance services specified herein is considered a minimum requirement for normal operation of vehicle. Under unusual operating conditions, such as high or low temperatures and dusty or sandy terrain, it may be necessary to perform certain maintenance services more frequently.

b. INSTRUCTIONS. If instructions other than those which are contained in the general procedures (*c* below) or in the specific procedures (*d* below) are required for the correct performance of a preventive maintenance service, or for the correction of a deficiency, consult other sections of this manual pertaining to the items involved or the designated individual in authority.

c. GENERAL PROCEDURES. General procedures are basic instructions to be followed when performing the services on the items listed in the specific procedures (*d* below).

Note. The second echelon personnel must be so thoroughly trained in these procedures that they will apply them automatically.

(1) When new or repaired assemblies are installed to correct deficiencies, see that they are correctly installed, and properly lubricated and adjusted.

(2) When installing new lubricant retainer seals, wipe a coating of the lubricant over the sealing surface of the lip of the seal. Soak new leather seals in OE 10 (warm if practicable) for at least 30 minutes; then work the leather lip carefully by hand before installing the seal. The lip must not be scratched or marred.

(3) The general inspection of each item applies to any supporting number or connection, and includes an inspection to see that the item is in good condition, correctly assembled, secure, and not worn.

(*a*) *Good condition.* An inspection to determine that the item is not damaged beyond safe or serviceable limits, and is not bent, twisted, chafed, burned, broken, cracked, bare, frayed, dented, collapsed, torn, or cut.

(*b*) *Correctly assembled.* An inspection to see that the unit is in its correctly assembled position in the vehicle.

(*c*) *Secure.* A hand feel, wrench, or pry-bar inspection for looseness, including brackets, lockwashers, lock nuts, locking wires, or cotter pins used in assembly.

(*d*) *Worn.* Worn close to or beyond serviceable limits, and likely to result in damage or failure if not replaced.

(4) *Special services.* These are indicated by repeating the item numbers in the columns which show the interval at which the services are to be performed and the parts or assemblies to receive certain mandatory services. For example, an item number in one or both columns opposite a *tighten* procedure means that the item must be tightened. The special services include—

(*a*) *Adjust.* Make necessary adjustments in accordance with the pertinent section of this manual, special bulletins, or other current directives.

(*b*) *Clean.* Clean items with solvent, dry cleaning, to remove lubricant, dirt, and other foreign material. After the parts are cleaned, rinse them in clean solvent and dry. Keep the parts clean until reassembled; keep cleaning fluid away from rubber or other material which it will damage. Clean the protective coating from new parts, since this material is not a lubricant.

(*c*) *Special lubrication.* This applies both to lubrication operations that appear on vehicle War Department Lubrication Order and to items that

do not appear on it, but which should be lubricated in connection with maintenance operations if parts are disassembled.

(*d*) *Serve.* This includes special operations, such as draining and filling items with oil, and cleaning the oil filter screen.

(*e*) *Tighten.* All tightening operations should be performed with sufficient wrench-torque (force on the wrench handle) to tighten the item according to good mechanical practice. Use torque-indicating wrench where specified. Tightening includes the replacement and correct installation of lockwashers, lock nuts, and cotter pins.

(5) *Conditions.* When conditions make it difficult to perform the complete preventive maintenance procedures at one time, they can sometimes be handled in sections; plan to complete all operations within 1 week.

(6) The numbers of the preventive maintenance procedures that follow are identical with those outlined on WD AGO Form 461 (Preventive Maintenance Service and Technical Inspection Work Sheet for Wheeled and Half-track Vehicles). Certain items on the work sheet that do not apply to this vehicle are not included in the procedures in this manual. In general, the numerical sequence of items on the work sheet is followed in the procedures, but in some instances there is deviation for conservation of the mechanic's time.

d. Specific Procedures. The procedures for performing each item in the weekly and monthly operating maintenance procedures are described in the following chart. Each page of the chart has two columns at the left edge corresponding to the monthly and weekly operating maintenance respectively. Frequently a particular procedure may not apply to both scheduled maintenances. To determine which procedure to follow, look down the column corresponding to the maintenance due, and whenever an item appears, perform the operations indicated opposite the number.

Maintenance	
Monthly	Weekly
1	1
5	5
6	6

WORK TEST

Note—Work test will include the operation of the vehicle with full capacity load. Perform work test for not less than 15 minutes nor more than 30 minutes.

Before-operation Service

Perform before-operation service as outlined in paragraph 23.

Brakes

Test frequently. Brakes must stop vehicle smoothly and effectively within reasonable distance without side pull, chatter, or squeak. Stop the vehicle on reasonable grade; with brake pedal in fully released position, brakes must hold vehicle securely, with reserve spring tension.

Clutches and Power Tilt Friction Drive

Clutches and friction drive must operate smoothly without chatter, grab, or slipping under load in each of their several positions.

a. Test clutch by applying motion control lever in forward and reverse positions. Apply lift lever in its raising and lowering positions; see that automatic stops function correctly.

b. Test tilt operation, actuated through power tilt mechanism friction drive, by moving tilt control lever in both directions. See that automatic stops function correctly.

c. Each operating lever must have 1-inch free travel at end of lever from neutral position (straight up) on control housing in backward and forward direction before meeting resistance, and must return freely to neutral position upon release.

d. With vehicle at rest on level ground, engine operating, tilt and lift mechanism in neutral positions, and brakes released, observe for creeping of any operating unit. Creeping indicates dragging clutches, or tilt friction drives, which must be adjusted.

Maintenance	
Monthly	Weekly
6	
6	
8	8
9	9
10	10
13	13
14	14
16	16

e. Observe lift and tilt mechanisms for smooth, uniform operation.

f. Inspect carriage lift chains for correct adjustment. Chains are at proper tension when the tension springs are slightly preloaded and the top shoulder of spring bolts are 3/8 inch from retainer washer. ***Caution:*** Do not use clutch levers to slow down or stop vehicle while in motion; use foot brake.

g. Remove both clutch case inspection covers and inspect clutch plates, dogs, collars, levers, and linkage for good condition. With operating levers in neutral position (straight up) on control housing, shifting collars should be in neutral between clutch dogs, and plates in all four clutches should be free. With any one clutch engaged, the opposite clutch plates must be free and must not drag. Inspect all four clutches for correct adjustment; replace worn or damaged parts and adjust if required. Reinstall inspection covers securely.

h. Inspect power tilt friction wheels, sprockets and drum for serviceable condition; see that composition friction wheel is securely applied to steel sprocket stem; see that both wheels are free of drum when tilt control lever is in neutral position. Adjust tilt friction mechanism if required; replace worn or damaged parts.

Steering

With vehicle in straight ahead position, observe for looseness and free play in assembly and steering hand wheel; observe for wander, shimmy, or side pull. Turn steering hand wheel to limit in both directions and note tendency to bind or lock.

Engine

Engine must idle smoothly without stalling. Test acceleration and power in lifting and movement operation. Listen for detonation (ping), misfiring, popping, or other noises indicating need for engine tune up or repair. Observe exhaust for unusual smoke indicating excessive oil or fuel consumption.

Unusual noises

Be alert for unusual noises from body, wheels, lifting, tilting, steering, and brake mechanisms indicating loose, worn, damaged, misaligned, or improperly adjusted parts or assemblies, or lack of lubrication.

Temperatures

Cautiously hand-feel brake drums and wheels for abnormally high temperatures. Overheating may indicate improperly adjusted brakes or wheel bearings.

Leaks

Look on ground under vehicle for fuel, oil, or water leaks.

Gear lubricant levels and leaks

After units have cooled, inspect crankcase, clutch, and tilt worm housing, and drive axle housing for correct lubricant levels. Add lubricant if required, or drain and fill as prescribed in WDLO 6004. Observe housings and case for leaks.

Maintenance	
Monthly	Weekly
17	17
18	18
	19
19	
	20
20	
21	
	23

MAINTENANCE OPERATIONS

RAISE VEHICLE — BLOCK SAFELY

Caution: Use necessary precautions to block the vehicle so it may be operated safely at reasonable speeds.

Unusual noises

Accelerate and decelerate engine and listen for unusual noises; locate and correct. Test individual vehicle functions with engine at fast idle. Listen for unusual noises and observe for undue vibration in operating units indicating loose, damaged, worn, or inadequately lubricated parts. Locate and correct deficiencies or report to designated individual in authority.

Cylinder head and gasket

Look for cracks or oil or compression leaks around studs, cap screws, and gasket. ***Caution:*** Cylinder head should not be tightened unless there is a definite indication of looseness or leaks (as determined after performing item 21). If tightening is necessary, use a torque-indicating wrench and tighten in accordance with good mechanical practice.

Valve mechanism

Listen for noisy valve action indicating excessive valve stem to lifter clearance. Adjust clearance if necessary.

ADJUST. Inspect clearance and adjust intake valve clearance between lifter and stem to 0.012 inch, exhaust valve clearance to 0.015 inch (engine hot).

See that springs, retainers, locks, and lifter are in good condition, tight, and correctly installed. Install new gasket and reinstall inspection cover securely.

Spark plug

Wipe off plug without removing; inspect for insulation cracks and leakage around insulation and gasket.

SERVE. Remove, clean, and adjust plug to gap of 0.025 inch. Replace if insulation is broken, electrodes are burned thin, or plug is otherwise unserviceable.

Note. If sand blast cleaner is not available, install new or reconditioned plug.

Compression test

With engine at normal operating temperature, remove the spark plug, test compression with choke and throttle wide open, rotate engine with starting crank by pulling up on the crank in quarter turns snap action, and record on the reverse side of WD AGO Form 461 the highest gauge reading obtainable. Compression pressure should read between 50 pounds minimum and 65 maximum, for good operating condition. If gauge reading is below 50-pound pressure, apply oil test (par. 40*b*) and report condition to designated individual in authority.

Crankcase

Drain and fill engine crankcase with lubricant as prescribed in WDLO 6004. Start engine, operate vehicle motion clutch, and inspect crankcase oil sump and crankcase inspection, timing gear, and valve spring covers for oil leaks; correct leaks.

Maintenance	
Monthly	Weekly
23	
	26
26	
	29
	29
	29
	29
	31
31	
31	

Engine oil pump

With magneto switch pulled out to OFF position, remove inspection plate on side of crankcase. Rotate engine by hand several times to see that pump is functioning properly and forcing oil out around connecting rod. Clean pump if required. Reinstall inspection plate securely.

SERVE. Semiannually, drain oil, remove inspection plate and oil sump from bottom of crankcase, remove pump, screen, and check-valves and clean thoroughly. Inspect parts for good condition. Replace defective parts. Reinstall. Fill crankcase with oil and test pump for correct functioning as described above; reinstall inspection plate securely.

Fan housing and flywheel

Inspect fan housing, front air inlet cover, flywheel air vanes, and starting crank adapter for serviceable condition, cleanliness, and secure attachment. Remove fan housing air inlet cover. Inspect flywheel for good condition and tightness on shaft; inspect starting crank adapter for serviceable condition and secure attachment to flywheel. Air vanes on flywheel must be open, clean, and unobstructed; clean if required. Remove housing from around engine cylinder and head. With stiff wire brush scrub air fins clean of all dirt. Reinstall housing and front air inlet cover securely. Tighten loose assembly bolts and nuts.

Drive belt, chains and sprockets

Inspect power tilt and power take-off drive belt and chain; see that belt is not damaged, greasy or frayed; see that chain and its connecting link and locking device are in good condition; test belt and chain for zero finger deflection. Inspect fork lift carriage chains for good condition and for correct tension; chains are at proper tension when the tension springs are slightly pre-loaded and the top shoulder of spring bolts are 3/8 inch from retainer washer. See that rollers are not pitted or broken. Inspect drive and idling sprockets for good condition, correct alignment, proper adjustment, and secure assembly. Replace damaged or defective belt, chains, or sprockets.

ADJUST. Carefully adjust belt and all chains for correct tension.

TIGHTEN. Tighten loose pulley or sprocket mountings.

CLEAN AND LUBRICATE. Clean and lubricate drive and lift chains. Be sure all rollers are free on links. Lubricate as prescribed in WDLO 6004.

Magneto

Inspect magneto for good condition and secure mounting. See that spring holds breaker housing cover securely in place.

CLEAN AND ADJUST BREAKER POINTS. Inspect breaker point chamber and clean. See that points are not pitted, burned, or out of alignment; replace if necessary. Adjust gap between points to 0.015-inch clearance.

LUBRICATE. At specified interval, lubricate rotor shaft as prescribed in WDLO 6004. Special lubrication. Semiannually, lubricate cam oil pad as prescribed in paragraph 21.

Maintenance	
Monthly	Weekly
32	
33	33
34	34
	35
36	36
37	37
40	40
41	41
42	42
47	47
	52

Coil, condenser, and wiring
Inspect coil and condenser for good condition; see that they are clean and free of moisture. Inspect ignition cable and magneto ground wire for good condition, tight and correct connections, proper insulation, cleanliness, secure support, and clearance from hot metal surface and vehicle parts.

Manifold
Inspect intake and exhaust manifold for cracks or sand holes. See that gaskets are in good condition and are not leaking. Tighten manifold flange nuts and exhaust pipe and carburetor connecting flange nuts evenly and securely.

Air cleaner
Inspect air cleaner for good condition and secure mounting. Weekly, remove air cleaner and wash in solvent, dry cleaning; dry and oil element as prescribed in WDLO 6004.

Crankcase breather
See that breather tube is in good condition, clean, and securely attached.

Carburetor
Inspect carburetor for good condition, correct assembly, secure mounting. See that choke and throttle linkage are in good condition, and that shutters open and close fully in response to controls. Lubricate linkage as required. Inspect; replace worn parts.

Fuel filter and lines
Remove and clean bowl and filter element. Inspect glass bowl for cracks. Inspect lines and connections between fuel tank and carburetor for leaks; correct leaks.

Leaks
Look around engine and beneath vehicle for fuel, oil, or water leaks. Trace leaks to source and correct.

Ignition timing
Test ignition for correct timing. Adjust timing as required.

Engine idle and vacuum test
Adjust engine to smooth idle; obtain highest possible vacuum reading.

Tires and rims
See that rubber has not separated from rims, that tires are not cut, torn, or otherwise damaged, and that treads are free from flat spots.

Remove embedded foreign objects from treads.

Replace worn or otherwise unserviceable tires.

Steering wheels
Without removing, inspect wheels for good condition; test for evidence of loose wheel bearing adjustment. Rotate wheels and listen for indications of dry, worn, or damaged bearings or hubs; observe for run-outs and cracked or broken wheels. Inspect steering fork, shaft, and sprocket for good condition, correct and secure assembly.

Maintenance	
Monthly	Weekly

TIGHTEN. Tighten loose axle or mounting bolts and nuts. Serve and lubricate. Semiannually, remove steering wheels and assembly. Wash and clean parts and inspect for good condition; replace worn or damaged parts. Lubricate bearings with grease as prescribed in WDLO 6004, with a packer or by hand, kneading lubricant into all spaces of bearings; pack inside of wheel hubs two-thirds full with WB grease and fill recess above fork shaft bearing with WB grease before reassembling. Protect bearings from dirt and immediately reinstall complete assembly. Adjust wheels and fork assembly securely.

	53

Brakes

Inspect pedal, linkage, brake spring, guide, and hold-down catch for good condition, correct alignment, proper adjustment, and secure assembly. Test by depressing foot pedal to floor for full release action; lock in this position with hold-down catch; rotate each wheel, and note any shoe drag. Remove catch and allow pedal to raise its full height, which should then place brakes in HOLDING or SET position; hand-test wheels for set position; test for equalization of brakes; see that brake spring has additional reserve tension. Adjust brakes for equalization and spring for reserve tension, if required.

54	

Brake shoes

Remove one driving wheel and clean grease and dirt from drum, backing plate, and parts. Inspect axle oil retainers for good condition and leaks; inspect linings for wear, oil, dirt, and possibility of rivets becoming loose or scoring drum before next inspection period. Inspect brake shoes, crank arm, links, and spring for good condition, security, tight and correct assembly. Reinstall wheel securely. If this wheel brake assembly requires attention, remove other wheel and inspect as above. Replace worn or damaged parts.

SERVE. Semiannually, in conjunction with item 60 inspect both wheel brake assemblies. Replace worn or damaged parts.

57	57

Steering mechanism

Inspect steering mechanism for good condition and correct and secure assembly. Test steering adjustment by turning steering hand wheel to limits in both directions; see that wheels do not lock, stick, or bind. Test hand wheel for looseness on shaft and for excessive slack in steering chain.

	57

TIGHTEN. Tighten and adjust steering assembly mounting nuts, sprockets, and chain.

57	

SERVE. Lubricate as prescribed in WDLO 6004. Serve and lubricate steering gear case. Semiannually, drain and fill, using suction gun to remove as much lubricant as possible. Examine carefully for worn parts; replace if required. Lubricate as prescribed in paragraph 21 and WDLO 6004.

Maintenance	
Monthly	Weekly
	60
61	61
63	63
66	66
	66
80	80
81	81

Driving wheels

Without removing, inspect wheels for good condition. Test for loose, worn, or damaged axles or bearings. Rotate wheels and observe for run-outs and cracked or damaged brake drums.

CLEAN. Semiannually, remove wheel bearings and seals, wash, clean, and inspect for damage. Inspect axles for proper alignment and axle oil retainers for leaks. Replace worn or damaged parts. Reinstall wheels securely. This procedure is to be performed in conjunction with item 54.

Drive axle housing

Inspect drive axle housing for correct alignment and lubricant seals for leaks; correct leaks. See that filler oil level and drain plugs and assembly and mounting bolts, cap screws and nuts are present and secure.

LUBRICATE. Daily, inspect lubricant for correct levels; add as required.

SPECIAL LUBRICATION. Semiannually, drain drive axle housing, remove inspection plate, and thoroughly inspect all gear assemblies, bearings, locks, and pinions for good condition and correct and secure assembly. Replace worn or damaged parts. Install inspection plate with new gasket and fill housing with lubricant as prescribed in WDLO 6004.

Engine mounting

See that mounting and assembly bolts connecting crankcase, clutch, and transmission case and drive axle housing are present, in good condition, and secure. Tighten loose mounting bolts and nuts securely.

Brake pedal

Inspect pedal and linkage for good condition, correct and secure assembly. Inspect spring guide for secure mounting. With pedal raised to extreme limit, see that spring has reserve tension.

ADJUST. Adjust spring for reserve tension.

Frame

Inspect chassis frame, supports, engine mount, masts, carriage, forks, engine frame, panels and control housing for good condition, proper alignment, and secure assembly; see that assembly bolts, nuts, and screws are present and secure.

Note. If frames, supports, braces, masts, or carriage are distorted, misaligned or damaged, report condition to designated individual in authority. Tighten loose mounting and assembly bolts, nuts and screws.

Ignition wiring

Inspect ignition cable and magneto ground wire for good condition, tight and correct connections, proper insulation, secure support, and clearance from hot metal surfaces and vehicle parts. Replace defective wiring.

Maintenance	
Monthly	Weekly
S2	S2
S2	
	84
84	
85	85
101	101
103	103
132	132
135	135
143	143

Fuel tank and lines

Inspect tank and fuel lines for good condition, secure mounting, and tight connections; inspect filler cap for defective gasket. See that cap is in good condition and that vent is clean and open.

SERVE. Remove fuel tank drain plug and drain accumulated water and sediment.

Exhaust pipe and muffler

Inspect exhaust and muffler assembly for good condition, tight and secure mounting; see that water filler cap is present, baffle plate perforations are open and unobstructed, and water float gauge is operating. Fill muffler with 2 quarts of water.

CLEAN AND SERVE. Remove muffler cover plate. Clean dirt, alkali, or corrosion from inside of water chamber, baffle plate and perforations, and elbow. See that cover is not cracked or warped. Use new gasket and reassemble. Replace defective parts.

Note. In localities where water has high alkaline or organic content, clean muffler more frequently.

Vehicle lubrication

Lubricate according to instructions on WDLO 6004. Observe latest lubrication directives.

LOWER VEHICLE TO GROUND

Counterweights

Inspect counterweights for good condition and secure mounting; see that all bolts are present and secure.

Paint and markings

Inspect paint of entire vehicle for good condition. Vehicle markings, identification plates, clutch adjustment instruction plate, and WDLO 6004 must be present, in good condition, securely attached, and legible.

Fire extinguisher

Inspect fire extinguisher for good condition, full charge, and secure mounting. See that nozzle is clean and open.

Publication

See that the vehicle WDLO 6004 is present, legible, and properly applied.

Forks

See that forks are not bent and that locking pins are in place and secure. See that forks are uniformily spaced on carrier to insure level handling of load.

Maintenance	
Monthly	Weekly
144	144
145	145
151	151
	151
	151
161	
141	141
142	142

Control levers and linkage

Inspect motion, lift, and tilt control levers and linkage for good condition, correct alignment, proper adjustment, and secure assembly. Lubricate levers and linkage as prescribed in WDLO 6004.

Lift chains

Inspect for wear. Keep chains sufficiently lubricated and free from dirt. Inspect for pitted or broken rollers, inspect the connecting link for serviceability and the locking device for security.

Do not use graphite; it cakes and causes stiffness.

Do not apply grease to outside surface of chains; it does not penetrate into the pin and inside of the rollers where rapid and excessive wear takes place.

Mast carriage assembly

Inspect inner and outer masts, brackets, carriage shoes, tilt control rack, and gear assemblies for good condition, correct and secure alignment; see that masts raise and lower without lag or binding.

TIGHTEN. Tighten assembly bolts and nuts. Replace broken or missing bolts and nuts.

CLEAN AND LUBRICATE. Clean and lubricate mast channels, tilt control rack, and gear and carrier idler sprockets as prescribed in WDLO 6004.

Power tilt take-off

Remove inspection plate and inspect drive chain, sprockets, shaft, and pulley for good condition, correct alignment, proper adjustment, and secure assembly. See that chain connecting link and locking device are in good condition; test chain for zero finger deflection.

ADJUST. Adjust chain to zero finger deflection.

Modifications (completed)

Inspect entire vehicle to be sure all Modification Work Orders have been completed. Enter any modifications or major unit replacements made at time of this service on WD AGO Form 478.

Final work test

Perform final work test, reinspecting items 5 to 17, inclusive. Reinspect crankcase, clutch and transmission case, tilt worm, and drive axle housing for correct lubricant levels, and leaks. Confine this test to minimum time necessary for satisfactory observations.

Note. Correct or report all defects found during final work test to designate individual in authority.

Section IV. TROUBLE SHOOTING

27. General

This section contains trouble shooting information and tests to help determine the causes of some of the trouble that may develop in this vehicle under average climatic conditions (above 32° F.). Each symptom of trouble given under the individual unit or system is followed by a list of possible causes of the trouble. The tests necessary to determining which one of the possible causes is responsible for the trouble are explained after each possible cause.

28. Engine

Symptom	*Possible cause*	*Remedy*
a. ENGINE WILL NOT START OR IS HARD TO START	(1) Inoperative ignition system.	(1) Inspect ignition system (par. 60).
	(2) Cylinder head loose.	(2) Tighten (par. 43).
	(3) Cylinder head gasket damaged.	(3) Replace gasket (par. 43).
	(4) Fuel system inoperative.	(4) Inspect fuel system (par. 48).
	(5) Piston rings broken, worn, weak, or stuck.	(5) Inspect cylinder compression and if low, replace piston rings (par. 97).
	(6) Valves held open due to insufficient lifter clearance.	(6) Adjust lifter (par. 44).
	(7) Valves held open due to warping or gum on stems.	(7) Clean and reface valves. Grind valve seat inserts (par. 90).
	(8) Valves have faulty seat in cylinder.	(8) Clean and reface valves (par. 90).
	(9) Engine parts seized due to overheating.	(9) Replace engine (par. 85).
	(10) Incorrect lubricant in engine and clutch.	(10) Replace lubricant in engine and clutch in accordance with instructions on WDLO 6004.
b. ENGINE MISFIRES WHEN IDLING.	(1) Faulty valve seat.	(1) Clean and reface valves. Grind valve seat inserts (par. 90).
	(2) Warped or pitted valve faces.	(2) Clean and reface valves. Grind or replace valve seat insert (par. 90).

Symptom	*Possible cause*	*Remedy*
	(3) Valve sticking.	(3) Remove cover over valve lifters and examine. If sticking, clean and reface valves and grind valve seat inserts or replace (par. 90).
	(4) Carbon on valve seat.	(4) Clean and reface valves and grind valve seat inserts (par. 90).
	(5) Valves burned.	(5) Replace (par. 92).
	(6) Valve spring broken.	(6) Replace (par. 92).
	(7) Incorrect valve lifter adjustment.	(7) Adjust (par. 44).
c. Engine Misfires at High Speed.	(1) Faulty valve action.	(1) See b above (1 to 7).
	(2) Cylinder head cracked.	(2) Replace head (pars. 42 and 43).
	(3) Leaky cylinder head gasket.	(3) Replace gasket (pars. 42 and 43).
	(4) Engine overheated.	(4) Allow engine to cool. Clean exterior parts. Inspect oil level and timing (par. 108).
	(5) Exhaust system partially restricted.	(5) Remove muffler and clean (par. 192).
d. Lack of Power.	(1) Insufficient cylinder compression.	(1) Inspect compression and correct (par. 40).
	(2) Restricted or clogged muffler.	(2) Remove muffler and clean (par. 192).
	(3) Engine oil too heavy.	(3) Drain flush and refill in accordance with instructions on WDLO 6004.
	(4) Clutch adjustment incorrect.	(4) Adjust clutch (par. 150).
	(5) Brake adjustment incorrect.	(5) Adjust brakes (par. 72).
	(6) Engine or ignition timing incorrect.	(6) Set timing (pars. 118 to 148).
	(7) Scored pistons.	(7) Replace (par. 98).

Symptom	*Possible cause*	*Remedy*
	(8) Engine overheated.	(8) Allow engine to cool clean exterior parts. Inspect oil level and timing.
	(9) Differential worn.	(9) Replace (par. 211).
c. Spark or Preignition Knock.	(1) Ignition timed too early.	(1) Adjust magneto timing (pars. 142 to 148).
	(2) Carbon in combustion chamber.	(2) Remove cylinder head and clean (par. 87).
	(3) Dirty spark plug.	(3) Remove clean and adjust (par. 62).
	(4) Engine overheated.	(4) Allow engine to cool and clean exterior parts. Inspect oil level and timing.

29. Ignition System

a. Engine Will Not Start or is Hard to Start.	(1) Loose or corroded connections.	(1) Clean and secure all wiring terminals.
	(2) Ignition wire insulation cracked, worn through, or oil soaked.	(2) Replace wiring (par. 62).
	(3) Ignition switch contacts loose, corroded, or burned.	(3) Replace switch (par. 61).
	(4) Fouled spark plug due to too rich fuel mixture.	(4) Clean plug (par. 40). Adjust carburetor (par. 51).
	(5) Fouled plug due to oil passing piston rings.	(5) Perform engine tune-up (par. 40).
	(6) Spark plug fouled due to being loose in cylinder head.	(6) Clean and tighten plug.
	(7) Damaged spark plug gasket.	(7) Replace gasket (par. 40).
	(8) Fouled plug due to improper use of choke.	(8) Use choke properly.
	(9) Spark plug point gap too wide.	(9) Adjust gap (par. 62).
	(10) Spark plug and wiring damp.	(10) Dry wiring and plug.

Symptom	*Possible cause*	*Remedy*
b. ENGINE MISFIRES WHEN IDLING.	(1) Loose or corroded wiring connections.	(1) Clean terminals.
	(2) Cracked, worn, oil soaked wiring.	(2) Replace wiring (par. 62).
	(3) Carburetor adjusted for too lean a mixture.	(3) Adjust carburetor (par. 40).
	(4) Engine oil passing piston rings and fouling spark plug.	(4) Perform engine tune-up (par. 40).
	(5) Spark plug loose in cylinder head.	(5) Tighten plug.
	(6) Spark plug gasket damaged.	(6) Replace gasket (par. 62).
	(7) Spark plug gap too wide or too narrow.	(7) Adjust gap (par. 62).
	(8) Dirty spark plug.	(8) Clean plug (par. 62).
	(9) Carburetor incorrectly adjusted.	(9) Adjust carburetor (par. 51).
c. ENGINE MISFIRES AT HIGH SPEED.	(1) Loose or corroded wiring connections.	(1) Clean terminals.
	(2) Ignition switch defective.	(2) Replace switch (par. 61).
	(3) Cracked, worn, or oil soaked wiring.	(3) Replace wiring (par. 61).
	(4) Breaker point gap incorrect.	(4) Adjust points (par. 63).
	(5) Breaker points dirty, pitted, or burned.	(5) Clean and adjust points (par. 63).
	(6) Breaker arm spring weak.	(6) Replace spring (par. 63).
	(7) Breaker points loose.	(7) Tighten breaker point screws (par. 63).
	(8) Ignition timing incorrect.	(8) Set timing (par. 143).
	(9) Weak condenser.	(9) Replace condenser (par. 142 and 148).
	(10) Spark plug defective.	(10) Replace plug (par. 62).
	(11) Spark plug loose.	(11) Tighten plug.

Symptom	*Possible cause*	*Remedy*
	(12) Carburetor incorrectly adjusted.	(12) Adjust carburetor (par. 40).
d. LACK OF POWER.	(1) Loose or corroded wiring terminals.	(1) Clean terminals.
	(2) Defective ignition switch due to burned contacts.	(2) Replace switch (par. 61).
	(3) Cracked, oil soaked, wet, or worn wiring.	(3) Replace wiring (par. 62).
	(4) Breaker point gap incorrect.	(4) Adjust points (par. 63).
	(5) Breaker points defective.	(5) Replace points (par. 63).
	(6) Incorrect ignition timing.	(6) Retime ignition (pars. 141 and 147).
	(7) Defective spark plug or gasket.	(7) Replace (par. 62).
	(8) Carburetor incorrectly adjusted.	(8) Adjust carburetor (par. 40).

30. Fuel System

a. ENGINE WILL NOT START OR IS HARD TO START.	(1) Intake manifold and cylinders flooded with fuel due to faulty choke operation.	(1) Crank engine with ignition off and carburetor throttle valve closed, then turn on ignition.
	(2) Air leaks at manifold gasket, carburetor gasket, or carburetor elbow gasket.	(2) Tighten attaching screws or replace gaskets (par. 41).
	(3) Carburetor choke valve fails to close fully when starting a cold engine.	(3) Adjust choke valve (pars. 132 and 135).
	(4) Carburetor float set too low.	(4) Adjust carburetor float lever (pars. 133 and 136).
	(5) Fuel line from sediment bowl to carburetor clogged.	(5) Clean fuel line (par. 52).
	(6) Restrictions in carburetor passages due to water, ice, or dirt.	(6) Clean carburetor (pars. 131 and 134).

Symptom	*Possible cause*	*Remedy*
	(7) Carburetor improperly adjusted.	(7) Adjust carburetor (par. 51).
	(8) Dirty air cleaner.	(8) Clean air cleaner (par. 49).
b. Engine Misfires When Idling.	(1) Carburetor idling adjustment incorrect.	(1) Adjust carburetor (par. 51).
	(2) Carburetor float set too high or too low.	(2) Adjust float level (pars. 131 and 134).
	(3) Restricted or clogged passage in carburetor.	(3) Clean carburetor (pars. 131 and 134).
	(4) Air leaks at manifold, carburetor, or carburetor elbow gaskets.	(4) Replace gaskets (par. 41).
c. Lack of Power.	(1) Carburetor float set too high, causing a flooded condition.	(1) Adjust float level (pars. 132 and 134).
	(2) Carburetor float set too low, causing a starved condition.	(2) Adjust float level (pars. 132 and 135).
	(3) Carburetor clogged.	(3) Clean carburetor (pars. 130 and 133).
	(4) Choke valve not fully open.	(4) Adjust choke valve (pars. 132 and 135).
	(5) Carburetor throttle lever loose.	(5) Tighten lever (pars. 132 and 135).
	(6) Throttle linkage not properly adjusted, preventing a full throttle opening.	(6) Adjust linkage (par. 51).
	(7) Carburetor incorrectly adjusted.	(7) Adjust carburetor (par. 51).

31. Engine Lubricating System

Low or No Oil Pressure.	(1) Lack of oil.	(1) Replenish oil supply. (See WDLO 6004.)
	(2) Oil of improper viscosity.	(2) Drain, flush and change oil. (See WDLO 6004.)

Symptom	*Possible cause*	*Remedy*
	(3) Continuous high speed operation.	(3) Normal condition.
	(4) Cylinder worn.	(4) Replace cylinder (par. 82).

32. Clutches for Vehicle Motion

a. Vehicle Continues Moving When Motion Control Lever is in Neutral.	Clutches not properly adjusted.	Adjust clutches (par. 150).
b. Lack of Power.	(1) Clutches out of adjustment, causing one clutch to work against the other or slipping.	(1) Adjust clutches (par. 150).
	(2) Incorrect or dirty oil.	(2) Change oil. (See WDLO 6004.)
c. Vehicle Will Not Move.	(1) Pinion gear broken.	(1) Replace pinion gear (par. 210).
	(2) Drive axle shaft broken.	(2) Replace (par. 207).

33. Clutches for Lift Mechanism

a. Lift Action Drags With No Apparent Power.	(1) Clutches out of adjustment, causing one clutch to work against the other or slipping.	(1) Adjust clutches (par. 150).
	(2) Incorrect or dirty oil.	(2) Change oil. (See WDLO 6004.)
b. Lift Mechanism Continues Operating When Lift Control Handle is in Neutral.	Clutches not properly adjusted causing one clutch to work against other or causing slipping.	Adjust clutches (par. 150).

34. Clutch and Transmission Case

a. Lift Mechanism Will Not Function.	(1) Damaged lift gears in clutch and transmission case.	(1) Repair (par. 210).
	(2) Broken bearings.	(2) Replace (par. 211).
	(3) Gears on clutch flange broken.	(3) Replace (par. 155).
	(4) Clutch discs worn.	(4) Reface or replace (par. 155).

Symptom	*Possible cause*	*Remedy*
b. DRIVE WHEELS WILL NOT TURN; DRIVE WHEELS MAKE GRINDING NOISE WHEN ROTATING.	(1) Differential in drive axle housing inoperative	(1) Repair differential (par. 209).
	(2) Broken bearings.	(2) Replace (par. 209).
	(3) Broken axle drive shaft.	(3) Replace (par. 209).
	(4) Bevel or intermediate gears broken.	(4) Replace gears (par 209).
c. GEARS CLASH.	(1) Damaged clutch gears.	(1) Replace clutch gears (par. 155).
	(2) Damaged drive axle gears.	(2) Replace gears (par. 209).
d. LIFT MECHANISM OPERATION DRAGS.	(1) Improper lubricant.	(1) Replace lubricant. (See WDLO 6004.)
	(2) Improperly adjusted clutch.	(2) Adjust (par. 150).
e. DRIVE AXLE HOUSING OVERHEATS.	No lubricant or lubricant level too high.	Adjust lubricant level. (See WDLO 6004.)
f. LUBRICANT LEAKS AT DRIVE SPROCKETS.	Oil seals in axle bearing covers worn.	Replace oil seal (par. 209).

35. Lift Mechanism

a. CARRIAGE DOES NOT SET LEVEL.	Lift chains not equalized.	Adjust chains (par. 78).
b. CHAINS BREAK BELOW HOIST SPROCKET.	(1) Incorrect adjustment of carriage stops.	(1) Adjust stops (par. 78).
	(2) No tension in tension spring.	(2) Adjust (par. 78).
c. CHAINS BREAK FREQUENTLY.	(1) Chains not equalized.	(1) Equalize chains (par. 78).
	(2) Chains stretched.	(2) Time chains (par. 78).
	(3) Carriage shoes worn.	(3) Replace shoes (par. 161).
	(4) Incorrect adjustment of stop.	(4) Adjust stops (par. 78).
	(5) Tilting mast forward when forks are on floor.	(5) Raise forks before tilting.
d. LIFT MECHANISM SLUGGISH IN OPERATION.	Clutches improperly adjusted.	Adjust clutches (par. 161).

Symptom	*Possible cause*	*Remedy*
c. Noisy Operation.	(1) Lack of lubrication.	(1) Lubricate. (See WDLO 6004.)
	(2) Sprockets worn.	(2) Replace sprockets (par. 160).
	(3) Sprocket pins worn.	(3) Replace pins (par. 160).
	(4) Chains loose.	(4) Adjust chains (par. 78).
f. Lift Mechanism Will Not Automatically Stop at Up or Down Position.	Stop adjustment incorrect.	Adjust stops (par. 78).
g. Masts Do Not Slide Easily.	Lack of lubrication.	Lubricate. (See WDLO 6004.)

36. Tilt Mechanism

a. Load Cannot Be Tilted.	(1) Mast tilt adjustment incorrect.	(1) Adjust forward and back tilt (par. 76).
	(2) Friction wheels incorrectly set.	(2) Adjust friction wheels (par. 76).
	(3) Drive belt adjusted incorrectly.	(3) Adjust drive belt (par. 76).
	(4) Broken parts in power take-off housing.	(4) Repair or replace (par. 176).
b. Masts Tilt Toward Rear and Cannot Be Tilted Forward.	(1) Bent lower tilt control rod.	(1) Straighten or replace (par. 182).
	(2) Not properly adjusted.	(2) Adjust collar (par. 76).
	(3) Grease on drum or friction wheels.	(3) Clean drum and wheels.
	(4) Drive belt adjusted incorrectly.	(4) Adjust drive belt (par. 76).
c. Tilt Drive Chain Breaks.	Drive chain adjustment incorrect.	Adjust drive chain (par. 76).
d. Tilt Mechanism Sluggish in Action With No Power.	(1) Drive belt too loose.	(1) Adjust drive belt (par. 76).
	(2) Friction wheels out of adjustment.	(2) Adjust friction wheel (par. 72).

Symptom	*Possible cause*	*Remedy*
e. TILT WILL NOT AUTOMATICALLY STOP IN FORWARD OR REAR POSITION.	Stops out of adjustment.	Adjust stops (par. 75).
f. MASTS HIT CONTROL HOUSING.	Tilt adjustment incorrect.	Adjust tilt stops (par. 75).

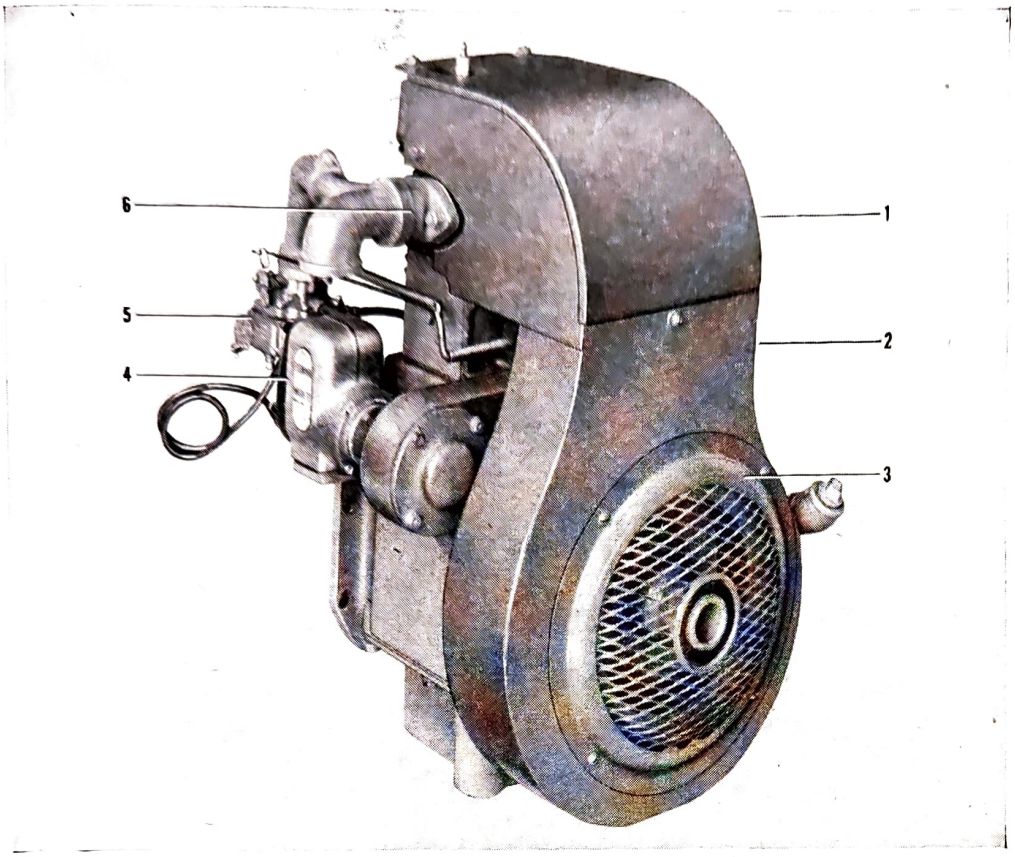
37. Steering System

a. VEHICLE WILL NOT STEER.	(1) Steering chain broken or off sprockets.	(1) Replace chain (par. 204).
	(2) Steering handwheel gears broken.	(2) Replace gears (par. 204).
	(3) Steering wheel fork bearing broken.	(3) Replace bearing.
	(4) Wheels loose on shaft.	(4) Tighten shaft nut (par. 74).
b. HARD STEERING.	(1) Lack of lubrication.	(1) Lubricate. (See WDLO 6004.)
	(2) Bind in steering chain.	(2) Adjust chain (par. 74).
	(3) Bind in steering shaft.	(3) Replace shaft (par. 204).
c. SHIMMY.	(1) Steering wheels loose on shaft.	(1) Tighten nut on shaft or replace wheel bearings (par. 204).
	(2) Excessive play in steering chain.	(2) Adjust chain (par. 75).
	(3) Sprocket loose on steering shaft or on steering wheel fork.	(3) Tighten sprocket (par.
d. MORE THAN A QUARTER TURN FREE TRAVEL AT PERIPHERY OF STEERING WHEEL.	(1) Loose steering chain.	(1) Adjust chain (par. 74).
	(2) Worn fork bearing.	(2) Replace bearing (par. 204).
	(3) Worn wheel bearings.	(3) Replace bearing (par. 204).
	(4) Worn needle bearing at bottom of steering shaft.	(4) Replace bearing (par. 204).
	(5) Loose fork nut.	(5) Tighten fork nut (par. 74)

Symptom	*Possible cause*	*Remedy*
38. Brake System		
a. BRAKES DO NOT HOLD.	(1) Brakes improperly adjusted.	(1) Adjust brakes (par. 72).
	(2) Brake linings worn.	(2) Reline brakes (par. 187).
	(3) Brake links improperly set.	(3) Reset links (par. 72).
	(4) Grease on linings.	(4) Replace linings (par. 167).
	(5) Defective or broken brake spring.	(5) Adjust or replace (par. 72).
b. BRAKES DO NOT RELEASE.	(1) Defective or broken brake spring.	(1) Adjust or replace (par. 188).
	(2) Binding in linkage.	(2) Adjust linkage (par. 189).
	(3) Brake links improperly set.	(3) Reset links (par. 73).
	(4) Grease on linings.	(4) Replace linings (par. 187).
	(5) Brake shoe retracting spring broken.	(5) Replace (par. 187).
c. BRAKES GRAB.	(1) Grease on linings.	(1) Replace linings (par. 187).
	(2) Brake drum out of round.	(2) Replace wheel (par. 73).
d. UNEVEN BRAKES.	(1) Brakes improperly adjusted.	(1) Adjust brakes (par. 72).
	(2) Grease on linings.	(2) Replace linings (par. 187).
	(3) Retracting spring broken.	(3) Replace spring (par. 187).
	(4) Brake drum out of round.	(4) Replace wheel (par. 72).

Section V. ENGINE

39. Description and Data



1. *Fan housing top cover.*
2. *Fan housing.*
3. *Fan housing front cover.*
4. *Magneto.*
5. *Carburetor.*
6. *Manifold.*

Figure 44. Left rear view of engine unit.

a. DESCRIPTION (figs. 44 and 45). (1) The power plant is a single-cylinder, four-cycle, air-cooled engine having a 3¾-inch bore and 4-inch stroke. At normal operating speed the engine develops 6 horsepower.

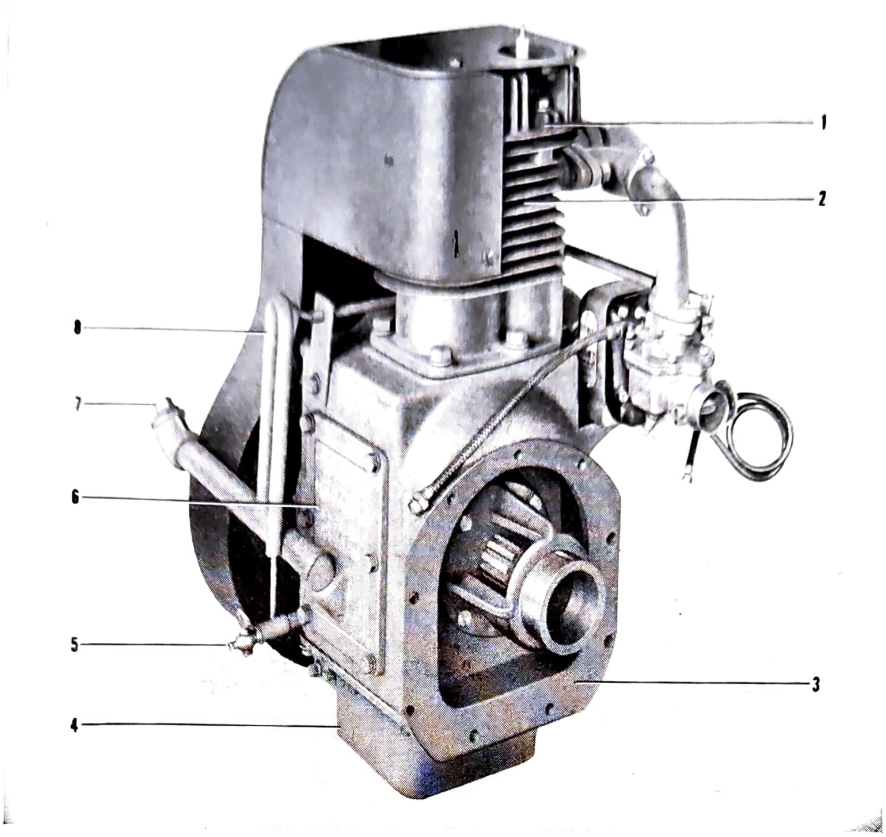
(2) The engine is located in the vehicle so that the flywheel is at an opening in front of the operators platform. Vanes and openings in the rim of the flywheel enable it to act as a fan. Air is drawn through the grilled flywheel opening and is directed, by means of a fan housing, around the cylinder. The cylinder and cylinder head are cast with fins on the outside to facilitate dissipation of heat.

(3) The magneto, carburetor, and air cleaner are mounted on the left side of the engine. The intake and exhaust manifold is secured to the left side of the cylinder. These parts are accessible by removing the two side plates secured to the left side of the vehicle by cap screws. A cover over the valve lifters can be removed for valve adjustment.

(4) The right side of the engine has an inspection cover on the crankcase which can be removed for cleaning the interior parts of the engine and for inspecting the connecting rod. The oil level cock and oil filler are on the right side of the engine. Access to the right side of the engine is by means of two side body covers attached by cap screws.

(5) The crankshaft is supported on adjustable roller bearings. The connecting rod bearings are of babbit metal which is cast into the rod and its cap.

(6) Pressure lubrication of the connecting rod and crankshaft bearings is by means of a plunger type pump located in the crankcase oil sump.



1. *Cylinder head.*
2. *Cylinder.*
3. *Crankcase.*
4. *Crankcase oil sump.*
5. *Oil level cock.*
6. *Crankcase inspection cover.*
7. *Oil filler plug.*
8. *Breather tube.*

Figure 45. Right front view of engine unit.

b. DATA.

Make of engine	Vaugn Motors.
Number of cylinders	1
Bore	3¾ inches.
Stroke	4 inches.
Horsepower	6
Gasoline consumption	2½ to 3 gallons per 8-hour day.

40. Engine Tune-up

a. GENERAL. (1) Perform the after-operation preventive maintenance and corrective operations listed in paragraph 25.

(2) Remove, clean, and adjust the spark plug. (See par. 62.)

(3) Tighten manifold nuts and if necessary, cylinder head screws. Tighten cylinder to crankcase cap screws.

(4) Tighten magneto and carburetor mounting screws.

(5) Lubricate engine. (See WDLO 6004.)

(6) Adjust valve lifter clearance. (See par. 44.)

(7) Clean magneto impulse mechanism. (See par. 63.)

b. COMPRESSION TEST. (1) Operate engine long enough to bring it up to a normal operating temperature.

(2) Remove spark plug cable from spark plug and remove spark plug.

(3) Install compression gauge in spark plug hole. Open choke and throttle fully. Rotate engine six revolutions and record reading on WD AGO Form 461.

(4) Compression pressure depends upon cranking speed, engine temperature, and compression ratio. If the compression gauge reading is approximately 50 to 65 pounds, the compression pressure is satisfactory.

(5) If the pressure is weak, inject a tablespoonful of oil into the spark plug hole while the piston

is at bottom dead center at beginning of compression stroke. Allow a few minutes for the oil to run down over the piston rings and then repeat test as instructed in (3) above.

Note. The oil is used to seal the piston rings. A low reading on the first test which remains low on the second test, indicates faulty valve seating. A low reading on the first test which becomes a high reading on the second test, indicates worn or defective piston rings or cylinder bore.

c. ELECTRICAL SYSTEM. (1) Remove and clean spark plug. Adjust spark plug gap to 0.025 inch. Test spark plug in testing machine.

(2) Clean and adjust magneto breaker points. (See par. 63.) If points are pitted or burned, replace the points. (See par. 63.) Lubricate magneto. (WDLO 6004.)

(3) Test timing of magneto to engine. (See par. 63.)

(4) Inspect condition of spark plug cable and ignition switch cable. Clean terminals of cables, magneto and switch.

(5) Remove spark plug wire from plug. Hold spark plug end of wire about ¼ inch away from the cylinder block. Crank the engine with ignition switch "on." A spark should jump the gap; if it does not, retime the magneto. (See par. 63.)

d. FUEL SYSTEM. (1) Clean sediment bowl and filter element. (See par. 52.)

(2) Remove and clean flexible fuel line with compressed air.

(3) Adjust carburetor. (See par. 51.)

41. Intake and Exhaust Manifold

a. DESCRIPTION. The intake and exhaust manifold is a one piece casting. Two exhaust elbows are threaded into each other and then screwed into the exhaust section of the manifold. The exhaust pipe leading to the muffler is screwed into one of the manifold elbows. The carburetor elbow is secured to the intake section of the manifold by cap screws.

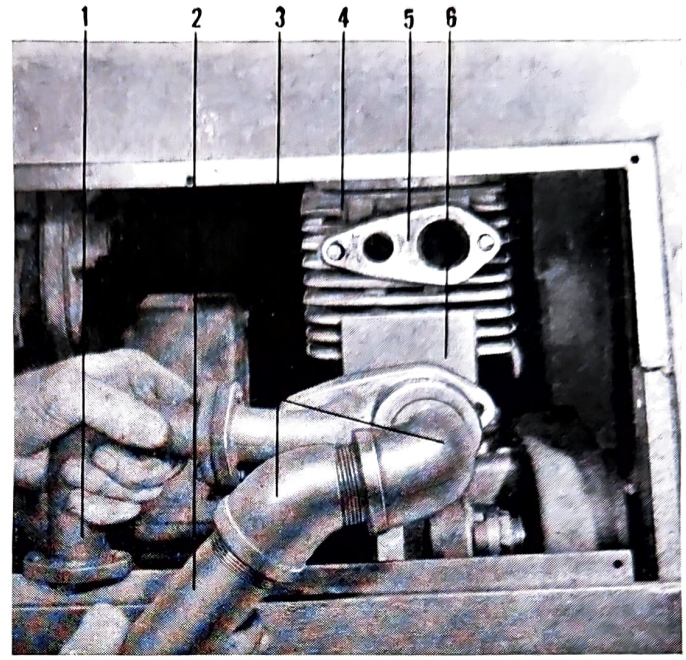
b. REMOVAL. (1) Unhook throttle spring from throttle bell crank and carburetor; detach upper throttle rod from throttle bell crank and carburetor.

(2) Remove two cap screws which secure carburetor to carburetor elbow and remove carburetor. Remove two nuts securing manifold to cylinder.

(3) Loosen manifold pipe union between manifold pipe and muffler pipe (fig. 78) and remove the intake and exhaust manifold unit (fig. 46). Remove manifold gasket.

c. INSTALLATION. (1) Install manifold gasket. Install the manifold unit and tighten the manifold pipe union. (See fig. 78.) Install two nuts securing manifold to cylinder block.

(2) Install carburetor on carburetor pipe and secure with two cap screws. Install upper throttle rod on throttle bell crank and carburetor.



1. *Carburetor elbow.*
2. *Manifold pipe.*
3. *Exhaust elbows.*
4. *Cylinder.*
5. *Manifold gasket.*
6. *Manifold.*

Figure 46. Removing manifold assembly.

(3) Hook throttle spring on throttle bell crank and carburetor.

42. Crankcase Inspection Cover

a. DESCRIPTION (fig. 45). The crankcase inspection cover is secured to the right side of the engine crankcase by cap screws. A crankcase breather tube is welded to the oil filler pipe, which is welded to the crankcase inspection cover.

b. MAINTENANCE. Be sure breather pipe is free of any obstruction. Clean dirt from pipe. Replace crankcase inspection cover gasket whenever cover is removed.

c. REMOVAL (fig. 45). Remove six cap screws and washers which secure the crankcase inspection cover to the crankcase. Remove cover and gasket.

d. INSTALLATION. (fig. 45). Install crankcase in-

spection cover and new gasket and secure cover to crankcase with six cap screws and lockwashers.

43. Cylinder Head and Gasket

a. DESCRIPTION (fig. 81). The cylinder head is located on the top of the cylinder. The gasket is located between the head and the cylinder.

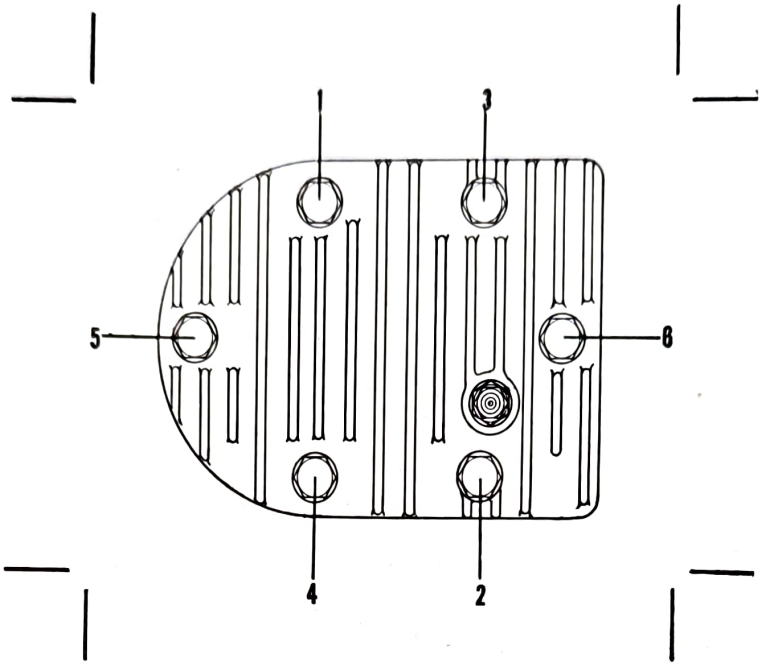


Figure 47. Cylinder head cap screw tightening diagram.

b. REMOVAL (fig. 81). (1) Disconnect spark plug wire at spark plug and disconnect choke rod at carburetor.

(2) Unscrew gasoline tank cap. Remove the two top screws which secure the control housing.

(3) Remove cotter and clevis pins which secure the brake pedal rod to the brake pedal. Remove rear body panel assembly from the vehicle. (See fig. 50.)

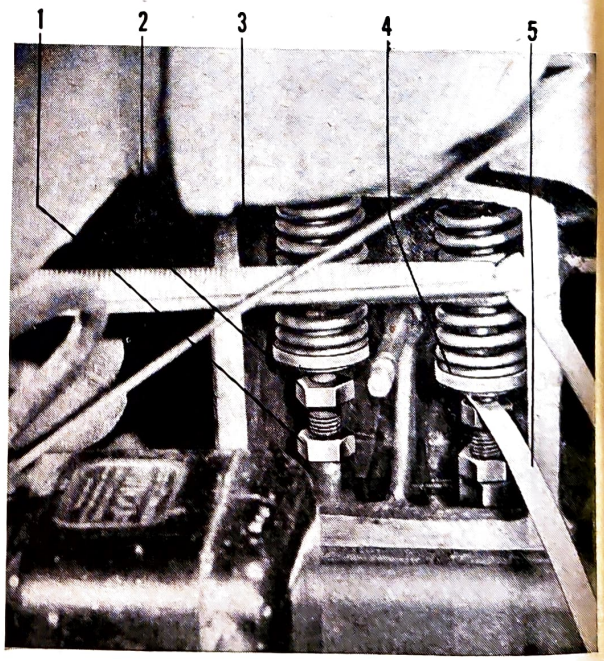
(4) Remove stove bolt which secures fan housing to fan housing top cover. Remove two nuts which secure top cover to cylinder and remove top cover.

(5) Remove cap screws which secure cylinder head to cylinder and remove cylinder head and gasket.

c. MAINTENANCE. With piston at top dead center remove all carbon from combustion chamber, top of piston and valve heads. *Caution:* Do not allow any of the particles to get on the cylinder walls. Use compressed air to clean carbon particles out of the head and combustion chamber.

d. INSTALLATION (fig. 81). (1) Apply a light coating of grease to top of cylinder block and to top surface of cylinder head gasket. Install gasket.

(2) Install cylinder head on gasket and then install and tighten cap screws. When tightening these cap screws start from the center of the head and work alternately toward the front and rear. After each cap screw is tightened evenly, try each with a



1. *Lock nut.*
2. *Adjusting screw.*
3. *Valve spring.*
4. *Valve spring retainer.*
5. *Feeler gauge—0.015 inch.*

Figure 48. Valve lifter adjustment.

torque wrench and draw all screws down to a 70 foot-pound torque. Go over each cap screw a second time as a final check. (See fig. 47.)

(3) Install fan housing top cover and secure with two nuts. Install stove bolt which secures fan housing top cover to fan housing.

(4) Install rear body panel assembly on the vehicle. Secure brake pedal rod to brake pedal with a cotter and clevis pin.

(5) Install the two top screws which secure the control housing.

(6) Connect choke rod to carburetor and spark plug wire to spark plug.

44. Valve Lifter Adjustment

a. GENERAL. Valve lifter adjustment must be correct. Insufficient clearance causes a loss of compression, missing, and eventual burning of the valves and valve seats. Excessive clearance tends to retard valve opening and to advance valve closing.

b. INSPECTION. Start engine. Inspect the clearance between the intake valve stem and the valve lifter adjusting screw with a 0.012 feeler gauge. Repeat procedure on exhaust valve, using 0.015 feeler gauge (with engine hot).

c. ADJUSTMENT (fig. 48). Remove nut securing the valve lifter cover. Remove the cover and gasket. With engine hot a 0.012 feeler gauge should just fit between intake valve stem and valve lifter adjusting screw when valve is in closed position; if it does not, loosen valve lifter adjusting screw lock nut and turn valve lifter adjusting screw down until 0.012 clearance is obtained. Repeat procedure on exhaust valve using 0.015 feeler gauge. Secure adjusting screw lock nut. Install new gasket with valve lifter cover.

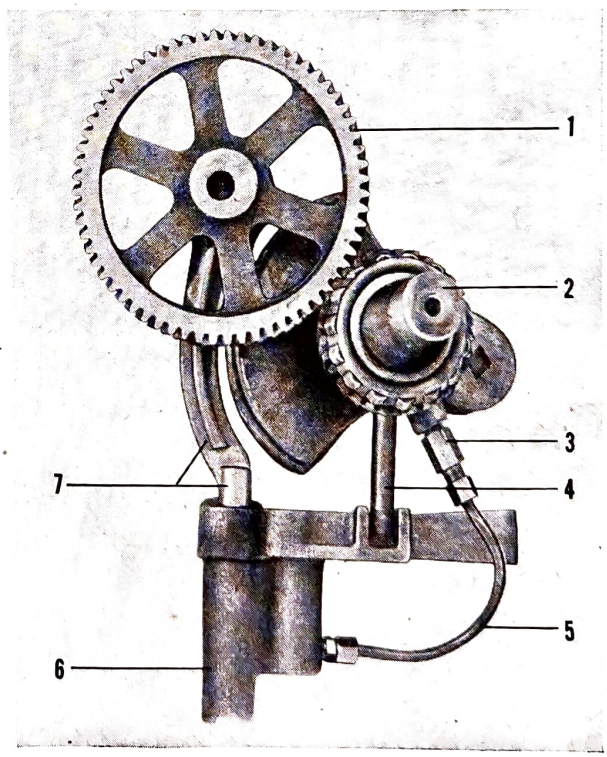
Section VI. ENGINE LUBRICATION SYSTEM

45. General (fig. 49)

a. The engine lubrication system consists of an oil pump located in the crankcase oil sump. This oil pump is operated by an eccentric on the camshaft to provide oil under pressure to lubricate the connecting rod bearing, crankshaft bearings, and the gears. The oil pump consists of the oil pump connecting rod and plunger; one end is attached on the camshaft and the other end slides up and down in the oil pump cylinder. Ball checks, an oil line, and a crankshaft collar provide the means of circulating the oil from the oil pump.

b. The part of the oil pump body, in which the connecting rod and plunger operate has a small opening with a ball check. Oil is drawn through an oil screen, past the ball check and into the bottom of the oil pump body by the suction or up stroke of the plunger. On the down or pressure stroke of the plunger, oil is forced out of the body and into a line which pipes the oil to the crankshaft collar. This crankshaft collar is circular and fits on the crankshaft. An oil groove is cut around the inner circumference of the collar and the oil line from the pump feeds the oil into this groove. A series of drilled holes connect the outer circumference of the collar to the oil groove in the inner circumference. Oil is forced out of this collar to lubricate the connecting rod, gears, and crankshaft bearings.

c. An oil passage in the oil pump body is connected to the oil pressure line on the crankshaft



1. *Camshaft gear.*
2. *Crankshaft.*
3. *Check valve.*
4. *Crankshaft collar.*
5. *Oil line.*
6. *Oil pump body cylinder.*
7. *Oil pump connecting rod and plunger.*

Figure 49. Engine lubrication parts.

collar. This passage has an oil relief valve consisting of a ball, spring, and a drilled pipe plug which closes the top of the passage and retains the spring. Oil pressure forces the ball check off its seat and against the spring pressure. The oil is then forced out of the drilled plug hole and onto the moving parts to further lubricate and form an oil spray inside the crankcase.

d. A dipper on the connecting rod cap agitates the lubricating oil and keeps an oil mist present in the crankcase to lubricate cylinder walls, piston, valve mechanism, and piston pin.

46. Crankcase Oil Sump and Gasket

a. DESCRIPTION (fig. 86). The crankcase oil sump, secured to the bottom of the crankcase, contains the oil for engine lubrication, the oil pump, oil screen and check, and pressure relief valves.

b. REMOVAL. Drain engine oil. Jack up rear of vehicle and remove cap screws which secure crankcase oil sump to the crankcase. Remove sump and gasket.

c. MAINTENANCE. Replace the oil sump gasket.

d. INSTALLATION. Install sump with new gasket and secure with cap screws. Lower rear of vehicle to the ground and fill engine with proper lubricant. (See WDLO 6004.)

47. Oil Screen

a. DESCRIPTION. The oil screen is located at the bottom of the crankcase oil sump, under the oil pump cylinder.

b. REMOVAL (fig. 86). (1) Drain engine oil. Jack up rear of vehicle and remove cap screws and washers which secure crankcase oil sump to crankcase. Remove sump and gasket.

(2) Remove ball check from oil pump body.

Note. This ball check is loose in the oil pump cylinder in the sump and will either fall out or can be removed by tipping the sump.

(3) Remove three cap screws which secure oil pump body to crankcase oil sump and remove pump body and oil screen.

c. INSPECTION. Clean oil screen thoroughly in solvent, dry cleaning, and allow screen to dry.

d. INSTALLATION (fig. 88). (1) Install oil screen and oil pump body. Secure pump body to crankcase oil sump with three cap screws.

(2) Insert ball check in oil pump cylinder.

(3) Install new crankcase oil sump gasket; install crankcase oil sump, and secure with cap screws and washers.

(4) Lower vehicle and fill engine with lubricant. (See WDLO 6004).

Section VII. FUEL SYSTEM

48. Description

a. INTAKE SYSTEM. The intake system consists of the air cleaner, carburetor, carburetor pipe, and manifold. The air cleaner is secured to the air intake of the carburetor and filters the air entering the carburetor. The carburetor atomizes the fuel and mixes it with air. The carburetor pipe carries the fuel and air mixture to the manifold. From the manifold the fuel mixture is drawn past the valves and into the cylinder by the suction stroke of the piston.

b. FUEL SYSTEM. The fuel system consists of the gasoline tank, fuel line and connections, fuel filter, and carburetor. The gasoline tank is secured to the body of the vehicle. Fuel flows by gravity from the tank through the fuel filter and fuel line to the carburetor.

49. Air Cleaner

a. DESCRIPTION (fig. 51). Air is drawn through holes in the top of the cleaner and passes through metal wool where dirt and dust are trapped.

b. DATA.

Make ..... Donaldson
Model ..... Simplex

c. REMOVAL (fig. 51). Loosen set screw and remove air cleaner from carburetor.

d. MAINTENANCE. Wash the air cleaner in solvent, dry cleaning. Soak the air cleaner in new engine oil for 5 minutes. Drain excess oil from cleaner.

e. INSTALLATION (fig. 51). Position air cleaner on carburetor and tighten set screw.

50. Fuel Tank

a. GENERAL. (1) 3½-gallon capacity fuel tank is located at the right rear corner of the vehicle, in front of the rear body panel. The fuel filter is attached directly to the bottom of the tank. A shut-

off cock is located at the bottom of the fuel filter.

(2) Whenever filling the fuel tank, take every possible precaution to avoid fire. Use a flashlight to inspect tank for quantity of fuel it contains. Always ground whatever is being used to fill the tank, by touching it to the vehicle after removing fuel tank cap. Keep container or metal part of hose in contact with funnel or vehicle while fuel is being admitted to tank.

(3) The fuel tank has an air vent in the filler cap which must be kept open at all times to assure proper flow of fuel to the carburetor.

(4) Thoroughly steam-clean interior of fuel tank and expel fumes before attempting to solder or repair any leaks in it. If brackets are loose, they should be brazed or spot welded. Paint exterior of tank to prevent formation of rust.

b. REMOVAL (fig. 50).

(1) Disconnect ignition switch wire at magneto and disconnect choke rod at carburetor.

(2) Unscrew fuel tank cap. Remove the top two screws which secure the control housing.

(3) Remove cotter and clevis pin which secure the brake pedal rod to the brake pedal. Remove the six cap screws and lockwashers which secure the rear body panel to the body.

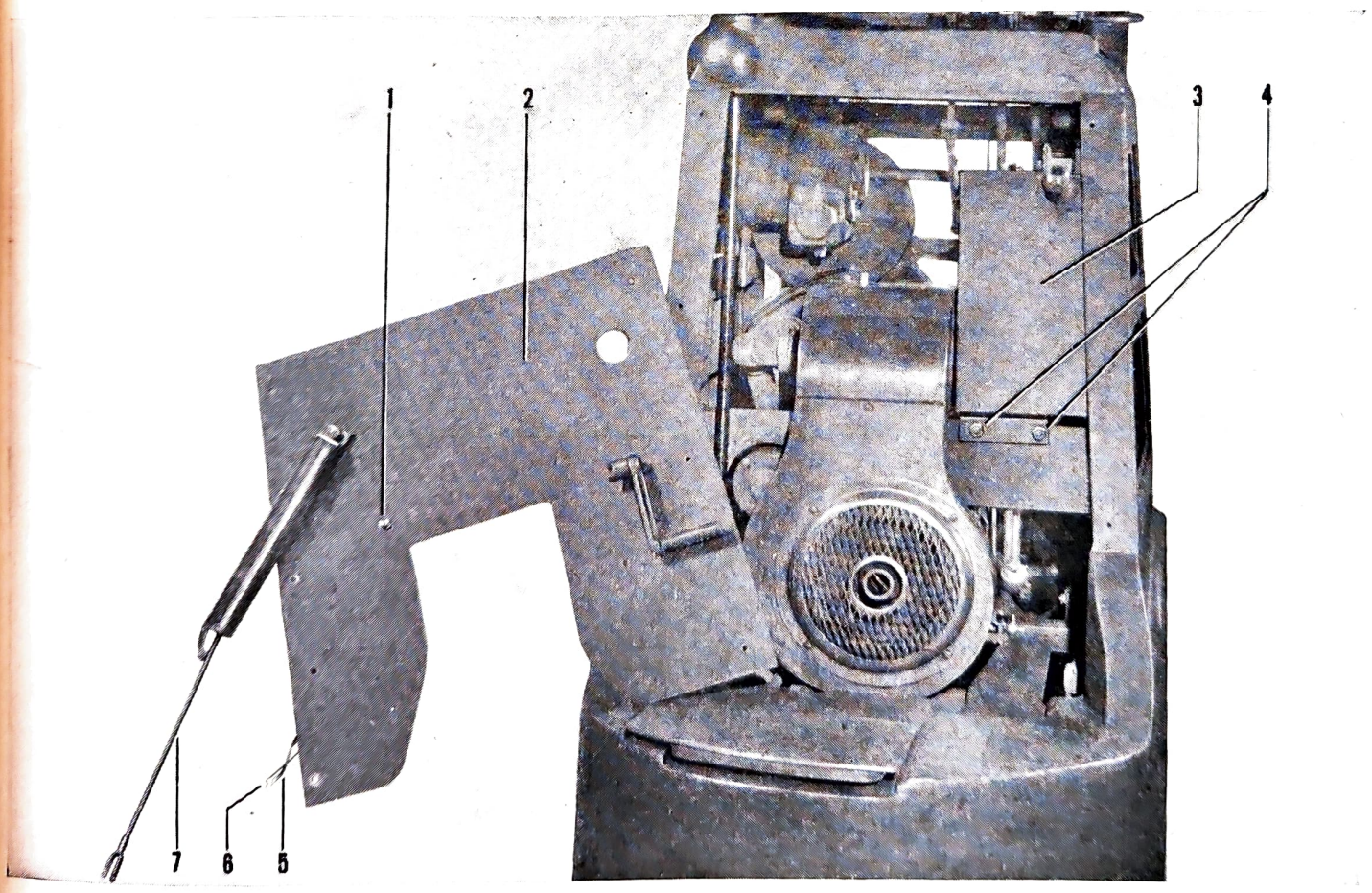
(4) Remove rear body panel assembly.

(5) Close shut-off cock at fuel filter. Disconnect fuel line at fuel filter.

(6) Remove two bolts, nuts and lockwashers which secure the bottom of fuel tank to the body. Remove cap screw and lockwasher which secure top of fuel tank to the body.

(7) Remove fuel tank.

c. INSPECTION. Inspect for dents, leaks, and rust spots.



1. *Ignition switch.*
2. *Rear body panel assembly.*
3. *Fuel tank.*
4. *Fuel tank bolts.*
5. *Ignition switch wire.*
6. *Choke rod.*
7. *Brake pedal rod.*

Figure 50. Rear body panel removed.

d. INSTALLATION (fig. 50). (1) Position fuel tank on vehicle and secure top of tank to body with cap screw and lockwasher. Install the two bolts, nuts, and lockwashers which secure the bottom of the fuel tank to the body.

(2) Connect fuel line to fuel filter. Open shut-off cock.

(3) Position rear body panel assembly on vehicle and secure with six cap screws and lockwashers. Attach brake pedal rod to brake pedal and secure with clevis and cotter pins.

(4) Secure top of control housing with two screws.

(5) Install fuel tank cap.

(6) Connect choke rod to carburetor; connect ignition switch wire to magneto.

51. Carburetor

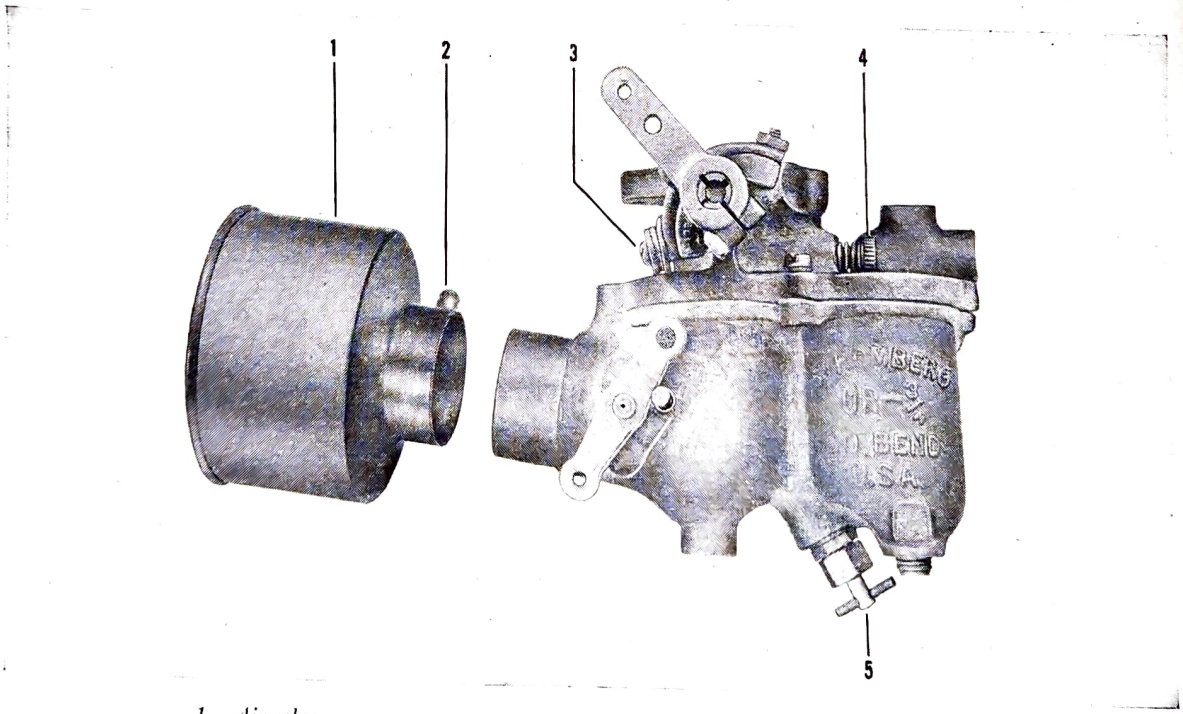
a. DESCRIPTION. The carburetor is mounted on the left side of the engine and is controlled by the action of the accelerator pedal. Two makes of carburetors have been used: Tillotson (model YC4A) and Stromberg (model UR ¾). Both carburetors are basically alike and have similar adjustments.

b. ADJUSTMENT (fig. 51). (1) *High speed adjustment.* Start engine and allow it to reach normal operating temperature. Operate engine at maximum speed and turn high speed adjustment clockwise until the engine starts to lose speed. This indicates that too lean a mixture is being fed to the engine. Turn high speed adjustment counterclockwise until the engine is operating at its maximum rpm. Turn the high speed adjustment one-fourth turn clockwise.

(2) *Idling speed adjustment.* Allow engine to idle. Turn idling speed adjustment in or out until engine operates smoothly.

(3) *Idle stop screw.* Turn stop screw on throttle arm in or out until engine idles without stalling.

c. REMOVAL. Disconnect fuel line at fuel filter. Disconnect choke rod at carburetor. Remove two cap screws and lockwashers which secure carburetor to carburetor pipe. Turn carburetor to one side and disconnect from upper throttle rod. Remove gasket from carburetor to carburetor pipe.



1. *Air cleaner.*
2. *Air cleaner set screw.*
3. *Idle stop screw.*
4. *Idling speed adjustment.*
5. *High speed adjustment.*

Figure 51. Carburetor and air cleaner.

d. INSTALLATION. Install new gasket. Connect upper throttle rod to carburetor and position carburetor on the carburetor pipe. Install two cap screws and lockwashers which secure carburetor to carburetor pipe. Connect choke rod to carburetor. Connect fuel line to fuel filter.

e. Adjust throttle valve opening. (See pars. 13 and 135.)

52. Fuel Filter

a. DESCRIPTION (fig. 52). The fuel filter is secured to a fitting in the bottom of the gasoline tank and is provided with a shut-off cock.

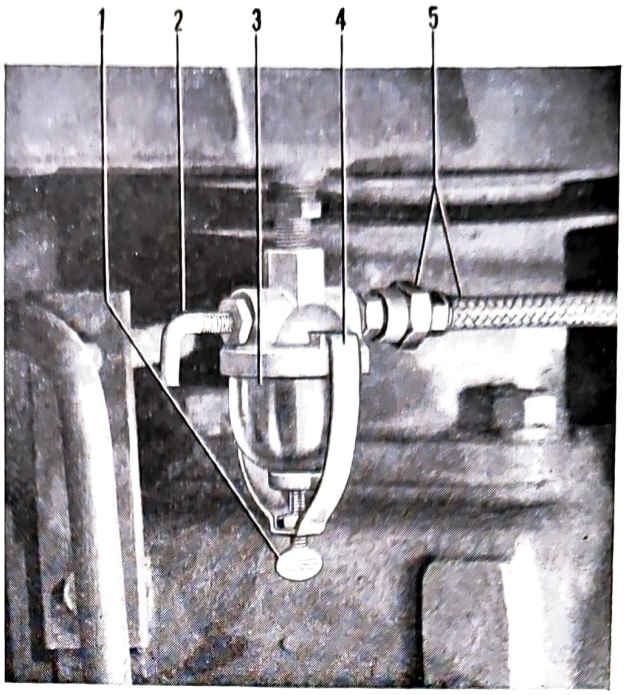
b. DATA.

Make ..... Zenith.
Type ..... F223X2.

c. REMOVAL (fig. 52). Turn shut-off cock in as far as it will go. Disconnect flexible line at fuel filter. Unscrew fuel filter from fitting in bottom of gasoline tank.

d. MAINTENANCE (fig. 52). Turn shut-off cock in as far as it will go. Loosen bail screw at bottom of fuel filter so that the bail holding the bowl in place can be moved to one side. Remove bowl and empty it, then clean thoroughly with clean rag. Remove filter element; clean and reinstall. Reinstall bowl, place bail in vertical position, and tighten bail screw. Remove and clean fuel line with compressed air. Reinstall.

e. INSTALLATION (fig. 52). Screw fuel filter in fitting in bottom of gasoline tank. Connect flexible line. Open shut-off cock.



1. *Bail screw.*
2. *Shut-off cock.*
3. *Sediment bowl.*
4. *Bail.*
5. *Fuel line with coupling.*

Figure 52. Fuel filter.

Section VIII. EXHAUST SYSTEM

53. General

The exhaust system consists of the manifold, exhaust pipe, and muffler assembly.

54. Maintenance

a. MUFFLER. Keep the muffler filled with 2 quarts of water.

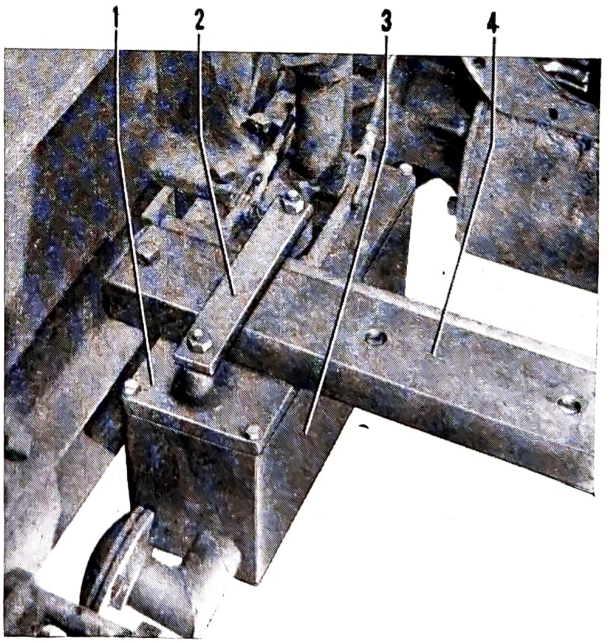
b. CONNECTIONS. Start engine. Inspect the exhaust elbow connections by coating the threaded connections with engine oil and look for bubbles indicating leaks. If leaks are indicated remove manifold assembly and tighten connections.

c. COUPLING. Repeat procedure in *b* above at exhaust pipe coupling.

55. Removal

a. REMOVE MANIFOLD. Remove manifold assembly as instructed in paragraph 41.

b. REMOVE MUFFLER (fig. 53). Remove two nuts and lockwashers which secure muffler strap to frame cross tie channel and remove muffler assembly.

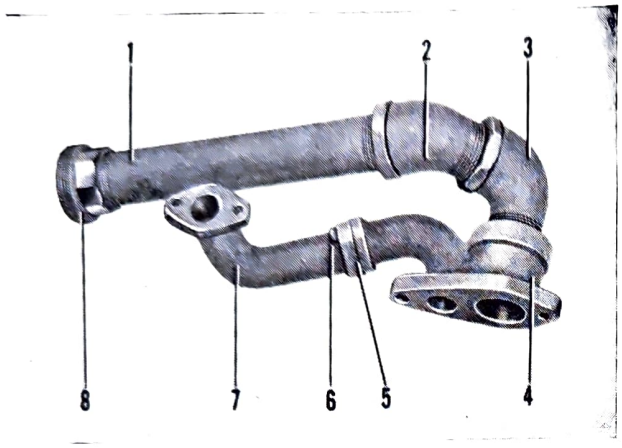


1. *Muffler cover.*
2. *Muffler strap.*
3. *Muffler body.*
4. *Frame cross tie channel.*

Figure 53. Muffler in position on vehicle.

56. Disassembly (fig. 54)

Remove cap screws and lockwashers securing carburetor pipe to manifold and remove pipe and gasket. Remove manifold pipe union nut, manifold pipe, 45° elbow, 90° elbow. Remove manifold from cylinder.



1. *Manifold pipe.*
2. *Exhaust elbow, 45°.*
3. *Exhaust elbow, 90°.*
4. *Manifold.*
5. *Gasket.*
6. *Cap screw.*
7. *Carburetor pipe.*
8. *Manifold pipe union.*

Figure 54. Manifold assembly.

57. Inspection and Repair

Inspect all threads for damage; straighten collapsed or burred threads with a thread die. Clean all parts in solvent, dry cleaning, and remove carbon accumulation inside the parts with a wire brush.

58. Assembly (fig. 54)

Be sure all parts are turned up tightly with a pipe wrench. Install carburetor pipe and a new gasket on manifold and secure pipe to manifold with cap screws and lockwashers. Install manifold on cylinder. Install 90° exhaust elbow, 45° elbow, manifold pipe, and manifold pipe union nut.

59. Installation

a. INSTALL MUFFLER (fig. 53). Install muffler assembly under frame cross tie channel and place muffler strap over the channel. Secure strap with two nuts and lockwashers.

b. INSTALL MANIFOLD. Install manifold assembly as instructed in paragraph 41. Fill muffler with 2 quarts of water.

Section IX. IGNITION SYSTEM

60. General

a. DESCRIPTION. The ignition system consists of the magneto, ignition switch, and spark plug. The magneto is secured to a bracket on the left side of the engine crankcase. A magneto timing gear is connected to the magneto by an adjustable coupling. This adjustable coupling provides one of the ways to adjust the magneto impulse starter which gives a retarded spark for starting. The magneto timing gear is driven by the camshaft gear.

b. OPERATION. The high voltage current generated by the magneto is conveyed by a cable to the spark plug, where a high voltage spark at the spark plug gap is delivered. Ignition is turned off or on by an ignition switch of the push-pull type which is connected to the magneto by a cable. If the switch knob is out, the magneto is grounded and the engine cannot be started.

61. Magneto Ignition Switch

a. GENERAL (fig. 9). The magneto ignition switch is located just above the choke control on the left side of the rear body panel. The switch is of the push-pull type, equipped with an external knob. When the knob is all the way out the magneto is grounded through the vehicle body, and the engine cannot be started. When the knob is in, the magneto is no longer grounded and current is supplied to the spark plug as soon as the engine is rotated.

b. MAINTENANCE. If the ignition switch knob is in the "in" or starting position and the engine cannot be started, remove the ignition switch cable from the short circuiting terminal on the magneto. Again try to start the engine. If the engine starts, the ignition switch or magneto to switch wire is defective and must be replaced. If the engine does not start, the cause must be other than the switch.

c. REMOVAL (fig. 50). Remove ignition switch cable from terminal on ignition switch. Turn the knurled nut off the face of the switch and, from inside the engine compartment, remove switch from inside of rear body panel.

d. INSTALLATION (fig. 50). Install ignition switch, from inside the engine compartment, on the inside of the rear body panel. Turn the knurled nut

on the face of the switch and then install ignition switch cable on ignition switch.

62. Spark Plug and Spark Plug Cable

a. GENERAL. The spark plug is located in the recessed hole in the cylinder head. The high voltage current arcs between the center (insulated) electrode and the single outer (grounded) electrode of the spark plug through a gap of 0.025-inch.

b. MAINTENANCE. The spark plug must be removed for inspection, cleaning, and adjustment. Always use the spark plug wrench in order to avoid cracking the insulator. Clean spark plug with sand blast cleaner. If a sand blast cleaner is not available, replace the spark plug with a new or reconditioned plug. Do not use a knife or scraper as insulator is very brittle and might break or crack. Inspect the spark gap with a round wire gauge. A gap of 0.025-inch must be maintained between the center and outer electrodes. If the gap is greater or smaller than 0.025-inch adjust by bending the outer electrode; never bend the center electrode. Be certain that the spark plug gasket is in good condition. Replace defective plugs. Spark plug cable insulation must be in good condition and the connections must be clean and tight.

c. REMOVAL. Disconnect magneto to spark plug cable and unscrew spark plug from cylinder head with a spark plug wrench. Remove spark plug gasket.

d. INSTALLATION. Install spark plug gasket and screw spark plug into the cylinder head with a spark plug wrench. Connect magneto to spark plug cable.

63. Magneto (Wico and Eisemann)

a. GENERAL. (1) *Description.* The Wico or Eisemann magneto is of the high tension type and is located on the left side of the engine. A bracket which is a part of the crankcase supports the magneto which is secured to the bracket by two cap screws and lockwashers. The magneto is rotated in a clockwise direction (looking from rear to front) by a magneto timing gear which is meshed with the camshaft gear. An impulse coupling is located in the front of the magneto to facilitate engine starting at low speeds by retarding the spark. A cover on the forward end of the magneto protects the breaker points, condenser and coil from dirt, damage and moisture. At the opposite end of the magneto is a removable cover over the impulse parts so that they can be reached for cleaning.

(2) *Tabulated Data:*

Magneto	Eisemann or Wico.
Rotation	Clockwise.
Ignition switch-magneto	Push-pull button type.
Breaker point gap-magneto	0.015 inch.
Impulse coupling advance	1/8 inch past TDC.
Spark plug size	14 mm–13/16 hexagon.
Spark plug type (AC–47)	Cold
Spark plug gap	0.025 inch.

b. MAINTENANCE. (1) *Timing to impulse spark (Wico or Eisemann).* When the impulse coupling is to be used in timing the magneto to the engine, remove the breaker cover and rotate the magneto shaft in the proper direction until the impulse coupling just trips. Rotate the engine to top dead center on the compression stroke, and couple the magneto to the engine.

(2) *Timing to advance spark (Wico or Eisemann).* Rotate the shaft in a direction opposite to its ordinary rotation until the breaker contacts are at point of opening. By means of a thin piece of paper between the points, the exact instant of breaker point opening can be determined. At this point, the magneto is in a position where a spark will be delivered to the cylinder. Rotate the engine until the piston is at top dead center and both the intake and exhaust valves are closed. Couple magneto to the engine.

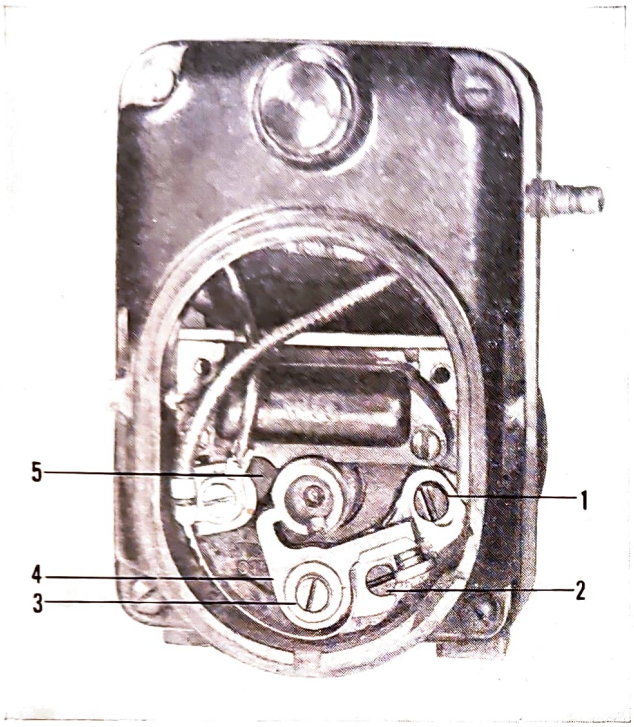
(3) *Lubrication.* The Wico magneto is provided with two oilers, one on each side of the main housing, so that which ever way the magneto faces the engine, one oiler will always be convenient. Lubricate at the intervals and with lubricant specified in War Department Lubrication Order. Relubricate the cam oil pad, in accordance with instructions in paragraph 19. The Eisemann magneto does not require lubrication except when disassembled.

(4) *Breaker point gap (Wico or Eisemann).* (*a*) At the time interval specified in the War Department Lubrication Order for lubrication of the breaker mechanism, inspect the breaker points for wear and correct gap setting, with the magneto mounted on the engine.

(*b*) To reach the breaker mechanism, release the spring clip which secures the cover over the breaker points and then remove the cover.

(*c*) Inspect the breaker points for wear or pitting.

(*d*) If breaker points are worn or pitted but not excessively so, dress with a flexible, abrasive non-conductive, contact point dresser. Remove the sta-



1. *Fixed contact point screw.*
2. *Gap adjusting screw.*
3. *Breaker arm screw.*
4. *Breaker arm.*
5. *Cam oil pad.*

Figure 55. Wico magneto breaker points.

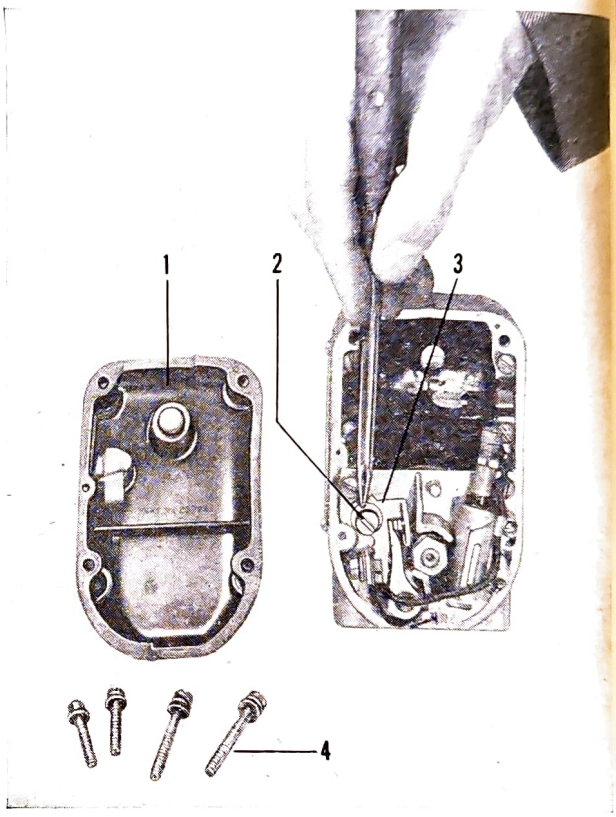
tionary point and the breaker arm with point in order to dress the points. Dress the outside edge of the stationary point for a 0.003- to 0.004-inch crown. Dress the breaker arm point flat.

(*e*) Before installing points, after dressing, thoroughly clean the stationary point support, breaker arm assembly, and the breaker compartment.

(5) *Breaker contact adjustment and replacement (Eisemann)* (fig. 56). (*a*) The gap between contacts, at full separation should be 0.015-inch. To adjust, remove cover.

(*b*) Rotate flywheel slowly, in reverse of normal operating direction to avoid impulse starter engagement, until breaker lever fibre rests on top of the breaker cam. Measure the gap between the contact points with a feeler gauge. The gap should be 0.015-inch. If the gap requires adjustment, loosen (do not remove) breaker plate fastening screw. Move the entire breaker assembly in either direction toward the cam to increase the gap. Move away from the cam to decrease the gap. Tighten breaker plate fastening screw and then measure the gap again. Do not disturb hexagon nut which secures breaker tension springs.

(*c*) To remove contact breaker, remove screw, lockwasher, and plain washer from end plate. Remove clip and spacing washer, and lift breaker from pivot pin in end plate.



1. *Cover.*
2. *Breaker plate fastening screw.*
3. *Breaker plate.*
4. *Cover screws.*

Figure 56. Eisemann magneto breaker points.

(6) *Breaker contact adjustment and replacement (Wico)* (fig. 55). (*a*) The high tension current is taken directly from the secondary terminal of the coil through the outlet in the cover of the magneto. To gain entrance to the breaker compartment, remove the breaker cover hold-down spring, and the breaker cover. Remove the breaker cover hold-down spring from the cover by wedging the spring away from the pins in the cover which secure it.

(*b*) Adjust the breaker points to .015 when fully opened by shifting the fixed contact point and gap adjusting screws. After adjustment, tighten the fixed contact screw.

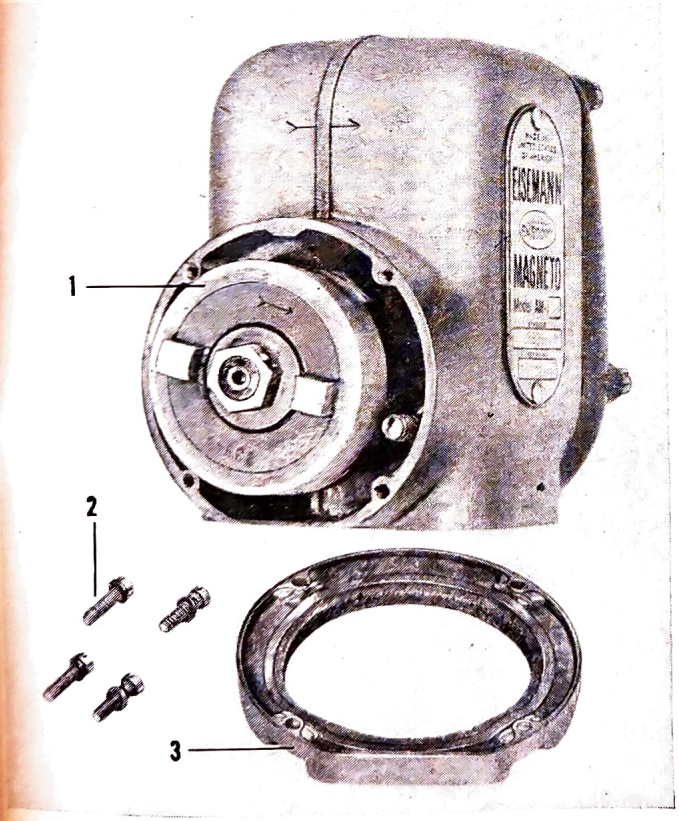
(*c*) Clean points with solvent, dry cleaning, and

adjust alignment so that surfaces of both contacts meet squarely.

(*d*) To remove the breaker arm, remove the breaker arm screw and lockwasher, clamp washer, breaker arm spring terminal screw, and lockwasher. Remove the breaker arm and the breaker arm spacer from the pivot. When reinstalling be sure that the leads from the coil and ignition switch are in place under the breaker arm spring terminal screw.

(*e*) To remove the fixed contact, remove the breaker arm as outlined above. Then remove the spacing washer, screw, lockwasher and washer. The fixed contact may then be removed from the breaker arm pivot.

(*f*) If the points need replacing, replace both the fixed contact and the breaker arm at the same time. After reassembling, adjust the points as instructed above.



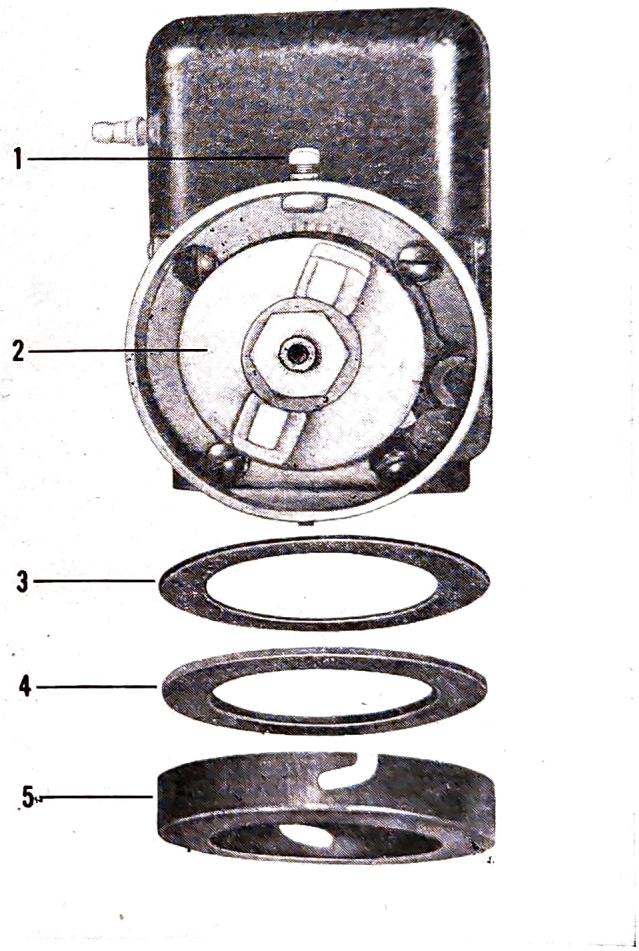
1. *Impulse mechanism.*
2. *Dust cover screws.*
3. *Dust cover.*

Figure 57. Eisemann magneto impulse mechanism.

(7) *Cleaning of impulse mechanism (Eisemann)* (fig. 57). Remove impulse starter dust cover and flush impulse starter by pouring solvent, dry cleaning, over the impulse starter pawls. Use a small can to avoid drenching the impulse body.

(8) *Cleaning of impulse mechanism (Wico)* (fig. 58). (*a*) At the time interval specified in the War Department Lubrication Order for lubrication of the breaker mechanism, flush the impulse mechanism. If the impulse parts become clogged with dirt, the trip arms will fail to engage or disengage, or the impulse action will be sluggish when it trips. Flush the impulse mechanism.

(*b*) Loosen impulse cover attaching screw and remove impulse cover by twisting it counterclockwise to remove the screw from the slot in the cover. Lift off the impulse cover gasket and spacer and flush the impulse mechanism with solvent, dry clean-



1. *Impulse cover attaching screw.*
2. *Impulse mechanism.*
3. *Spacer.*
4. *Impulse cover gasket.*
5. *Impulse cover.*

Figure 58. Wico magneto impulse mechanism.

ing. Be careful that none of the solvent enters the magneto housing.

(*c*) Install impulse spacer, impulse cover gasket, and impulse cover. Tighten impulse cover attaching screw.

c. Removal (Wico or Eisemann). (1) Disconnect wires leading from the magneto to the spark plug and to the ignition switch. Remove breaker point cover and note the position of the rotor so that magneto can be reinstalled in the same position.

(2) Remove the two cap screws and lockwashers which secure the magneto on its bracket and remove magneto from its coupling.

d. Installation (Wico or Eisemann). (1) Install magneto on its bracket with the rotor in the same position as when removed.

(2) Install the two cap screws and lockwashers which secure the magneto on its bracket. Connect wires to spark plug and ignition switch.

Note. If engine has been rotated or position of rotor upon removing is not known, retime the magneto as instructed in *b* above.

Caution: When installing the series C WICO magneto see that the drive members and lugs of the magneto drive cup are properly aligned. Inspect alignment before tightening the magneto mounting screws by rotating the engine; the float member must have sufficient end play during each turn of the cycle. Be sure that the screws clamp the magneto securely and do not just bottom in the tapped holes of the magneto.

Section X. CLUTCHES

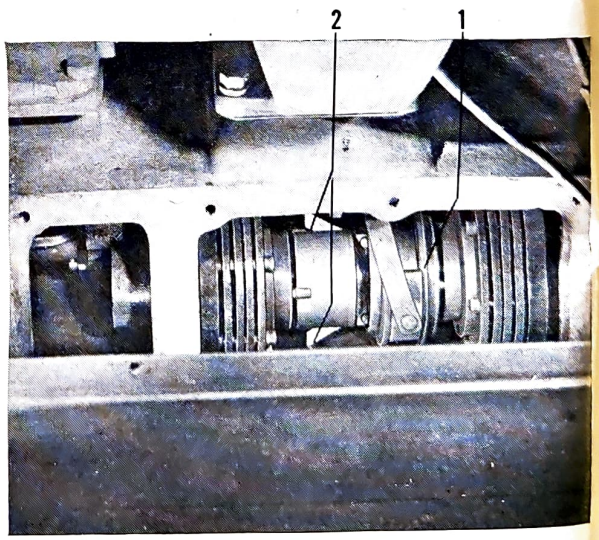
64. General

a. Description. The four clutches (fig. 4) perform the same duty as a conventional transmission. Two clutches control forward or reverse motion and two clutches control raising or lowering of the carriage. The four clutches are located in a case which is secured to the engine at one end and to the drive axle housing at the other end. Engine power is transmitted through a main drive shaft to the clutch shafts to provide forward or reverse vehicle motion or up or down motion of the carriage. A gear at one end of the main drive shaft meshes with gears on the clutch shafts to provide forward motion of the vehicle and down movement of the carriage. A gear at the other end of the main drive shaft meshes with an idler gear which is in mesh with the gears on the clutch shafts. The use of this idler gear provides reverse motion of the vehicle and up movement of the carriage. The clutch plates are engaged or disengaged by means of a shift collar which is controlled by the motion control or lift control lever.

b. Operation (fig. 59). All four clutches operate in the same manner. Moving the motion control lever to its "forward" position engages the rear clutch on the right side of the case; moving the lever handle to its "reverse" position engages the front clutch. Moving the lift control lever to its "up" position engages the front clutch on the left side of the vehicle; moving the lever to its "down" position engages the rear clutch.

65. Clutch Maintenance and Adjustment

a. Maintenance. Inspect lubricant level in clutch case and maintain the oil level as specified in War Department Lubrication Order. Inspect clutch case for lubricant leaks.



1. Clutch shifter collar. 2. Clutch dogs.

Figure 59. Clutch in position to move vehicle forward.

b. Adjustment. (1) *Lift control.* There should be no movement of the carriage when the lift control lever is in its neutral position. Inspect as follows:

(*a*) Remove the screws which secure the left lower body cover to the body and remove the cover. Remove the screws which secure the cover on the left side of the clutch case and remove the cover.

(*b*) Place lift control lever in neutral and inspect the position of the clutch shifter collar. (See fig. 58.) Move the collar back and forth several times. The collar should contact the shifter fork stop (fig. 103); if it does not, notify designated individual in authority.

(2) *Motion control.* There should be no movement of the vehicle when the motion control lever is in its neutral position. Inspect as follows:

(*a*) Remove the screws which secure the right lower body cover to the body and remove the cover. Remove the screws which secure the cover on the right side of the clutch housing and remove the cover.

(*b*) Place motion control lever in neutral and inspect the position of the clutch shifter collar. (See fig. 59.) Move the collar back and forth several times. The collar should contact the shifter yoke stop (fig. 103); if it does not, notify designated individual in authority.

66. Clutch External Connections

a. General. The external connections for the clutches for the lift and motion control consist of the lift and motion control levers and the operating rods attached to the levers and to the clutch shifter collar.

b. Maintenance. The threaded clevis on the operating rods are used to shorten or lengthen the linkage to the clutch shifter collar in order to maintain it in its neutral position. Refer to *d* below for adjustment procedure.

c. Removal. Remove the cotter pins from the operating rod adjustable yoke pin and remove the yoke pin. Repeat the operation at the opposite end of the rod. Remove the operating rod.

d. Installation. Install the operating rod and operating rod adjustable yoke pin. Repeat the operation at the opposite end of the rod. Install cotter pins in the yoke pins. Adjust the length of the rod by turning the clevis so that lift or motion control lever is in neutral when the clutch shifter collar is in neutral.

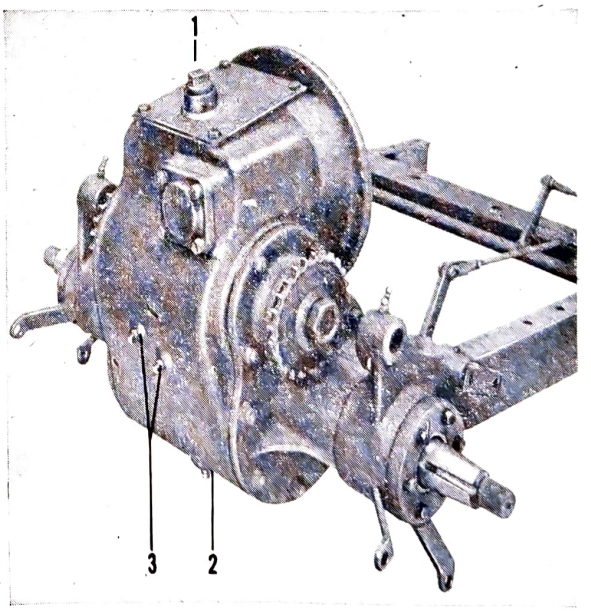
Section XI. DRIVE AXLE HOUSING

67. General

The power of the engine is transmitted through any one of the four disk-operated clutches to the drive axle housing unit. A gear on the end of the lift clutch shaft engages an internal toothed gear in the drive axle housing to operate lift drive sprockets on which the lift chain operates. A pinion gear on the end of the motion clutch shaft engages gears in the drive axle housing to operate a differential and the driving wheels.

68. Maintenance

The drive axle housing has two level plugs for determining the level of the lubricant and a filler plug. Inspect lubricant level and fill at intervals specified in the War Department Lubrication Order. A drain plug in the bottom of the drive axle housing provides means for changing lubricant. Drain and refill as specified in the War Department Lubrication Order. Inspect for leaks at time of preventive maintenance inspections. (See pars. 22 to 26.)



1. Filler plug. 2. Drain plug. 3. Level plugs.

Figure 60. Drive axle housing assembly.

Section XII. WHEELS AND TIRES

69. Driving Wheels

a. General. The front or driving wheels are equipped with pressed on solid rubber tires. The wheels are keyed on tapered axle drive shafts. An axle housing bearing cover containing an oil seal is mounted on the end of the axle housing. If this

oil seal becomes worn or damaged it will allow oil from the axle housing to leak onto the brakes.

b. MAINTENANCE. (1) *Tires.* To secure maximum lift and satisfactory performance, avoid operating the vehicle over sharp projections that will tear or gouge out pieces of the rubber. Remove nails and other foreign matter that will cut the rubber. Use a tire press to press a tire off or on.

(2) *Wheels.* Remove the driving wheels. Inspect the keyway in the axle shaft and the key which secures the wheels on the axle shaft. Replace axle shaft if keyway is chipped. (See par. 210.) Insert the key in the keyway; if the key is a loose fit in the keyway replace key and axle shaft. Try the key in the keyway in the wheels; if key is loose, replace wheel key and axle shaft. Inspect brake drum; turn down on a lathe if scored.

(3) *Oil seal.* After wheel is removed, inspect the axle shaft, brake drum, and brake lining for evidence of lubricant. If lubricant is present replace the oil seal by removing the six cap screws and lockwashers which secure the axle housing bearing cover and removing the gasket and cover. Remove oil seal from cover and press in a new oil seal.

c. REMOVAL. Jack up drive wheel clear of the floor. Remove cotter pin and wheel lock nut. Remove wheel using puller.

d. INSTALLATION. See that wheel key is in place on the axle shaft and install wheel so that keyway in wheel is alined with the key. Install wheel on axle shaft far enough to start wheel nut on axle shaft. Turn nut up tight and install cotter pin.

70. Steering Wheels

a. GENERAL. The steering handwheel operates wheels mounted underneath the counterweight at the rear of the vehicle. These steering wheels consist of two hard rubber tires mounted on two wheels and rotating on ball bearings which are pressed on a steering wheel shaft.

b. MAINTENANCE. Maintenance of the steering wheel is the same as the driving wheel. (See par. 69*b*.)

c. REMOVAL. Jack up the rear end of the vehicle. Remove cotter pins which secure nuts on steering wheel shaft and remove the nuts. Press steering wheel shaft out of the bearings. Remove the steering wheel spacer which is between the two wheels.

Note: One side of the wheel yoke has a keyway in it. The steering wheel shaft must be pressed from the side opposite this keyway.

d. INSTALLATION. Place the steering wheel spacer between the two wheels and press steering wheel shaft through the wheels and bearings. Install the steering wheel shaft nuts and secure with cotter pins.

Section XIII. BRAKES

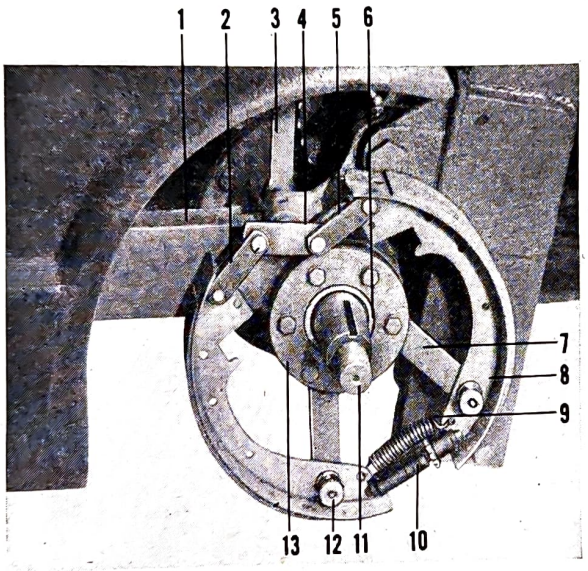
71. General

The brake pedal on the left side of the operator's platform actuates brake shoes against brake drums which are a part of the driving wheels. When the brake pedal is in its "up" position the brakes are applied. The pedal can be locked in its released position by a brake pedal hold-down catch located at the left of the operator's platform. Brake linkage connects the brake pedal to the brake shoe crank.

72. Maintenance

Brakes should not drag but should hold vehicle stationary when the brake pedal is in its "up" position. All adjustment for wear of the brake lining is made by means of the brake adjusting screw which can be reached from inside the driving wheels. Depress the brake pedal to turn the screw. Turn the adjusting screw clockwise to tighten the brakes. Brakes on both drive wheels must be adjusted equally. To test for equalization of adjustment, operate the vehicle and release the brake pedal; note carefully for side pull.

Caution: If the brake adjusting screw is not sufficiently extended, the brakes will not be effective. If the brake adjusting screw is lengthened (extended) too much, the brakes will drag.

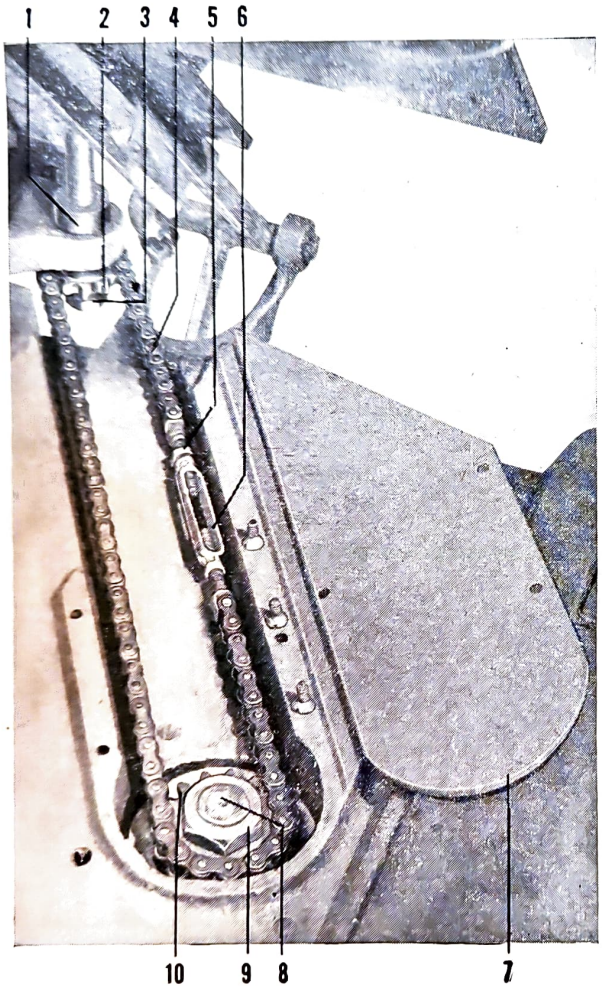


1. *Frame channel.*
2. *Brake shoe link.*
3. *Brake lever and sleeve.*
4. *Brake shoe crank.*
5. *Brake shoe link.*
6. *Oil seal.*
7. *Brake shoe support.*
8. *Brake shoe.*
9. *Brake shoe retracting spring.*
10. *Brake adjusting screw.*
11. *Axle drive shaft.*
12. *Brake shoe spring retainer anchor pin and spring.*
13. *Axle housing bearing cover.*

Figure 61. Brake assembly, showing correct position of brake shoe links.

73. General

The steering gear assembly consists of the steering handwheel, reduction gears, steering shaft, steering shaft sprocket, and steering chain. The steering wheel assembly consists of the steering wheel fork complete with wheels, sprocket, spindle, and nut.



1. *Steering shaft collar.*
2. *Steering shaft sprocket.*
3. *Steering shaft sprocket nut.*
4. *Steering chain.*
5. *Chain adjusting turnbuckle lock nut.*
6. *Chain adjusting turnbuckle.*
7. *Counterweight cover plate.*
8. *Steering wheel fork spindle.*
9. *Steering wheel fork spindle nut.*
10. *Steering wheel fork sprocket.*

Figure 62. Steering gear chain adjustment.

The steering chain functions as a drag link, providing an adjustable connection between the steering shaft and the steering wheel.

74. Maintenance

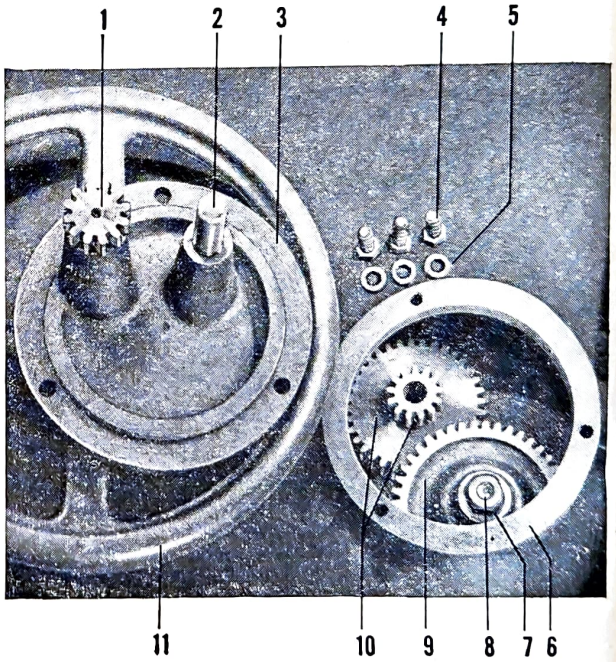
a. Inspect Steering Gear Play. Turn steering handwheel. If free travel on periphery of steering handwheel exceeds 2 inches, adjust the steering chain.

b. Adjust Steering Chain (fig. 61). (1) Reach under the brake pedal and remove screws securing counterweight cover plate on the counterweight.

(2) Loosen chain adjusting turnbuckle lock nut and turn turnbuckle until all slack is removed from chain. Tighten the chain adjusting turnbuckle lock nut.

c. Tighten Sprocket Nuts (fig. 62). Tighten steering shaft sprocket nut and steering wheel fork spindle nut.

d. Reinstall Counterweight Cover Plate. Secure with the screws.



1. *Steering handwheel gear.*
2. *Idler gear shaft.*
3. *Control housing cover.*
4. *Screws.*
5. *Lockwashers.*
6. *Control housing.*
7. *Steering shaft nut.*
8. *Steering shaft.*
9. *Steering shaft gear.*
10. *Steering idler gear and pinion (pinion meshes with steering shaft gear).*
11. *Steering hand wheel.*

Figure 63. Steering handwheel assembly removed.

e. Tighten Steering Shaft Nut. (1) Remove three screws and lockwashers which secure control

housing cover on control housing and lift steering handwheel assembly off. (See fig. 63.)

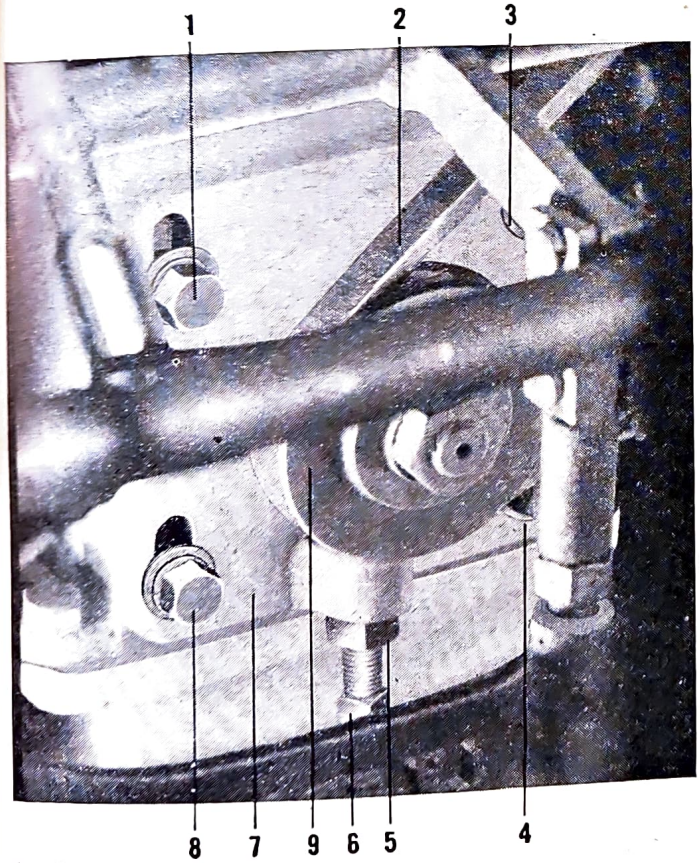
(2) Tighten steering shaft nut. (See fig. 63.)

(3) Reinstall control housing cover and steering handwheel on control housing and secure with three screws and lockwashers.

Section XV. TILT MECHANISM

75. General

The tilt mechanism is operated by engine power transmitted through a power take-off situated on the top of the clutch housing. The power is carried through an adjustable drive belt to an intermediate gear assembly. An adjustable drive chain drives two friction wheels which contact a friction drum to give forward or back tilt to the masts and load. These friction wheels are adjustable to properly position them with the drum. The friction drum operates a worm and gear which operates two racks secured to the masts.



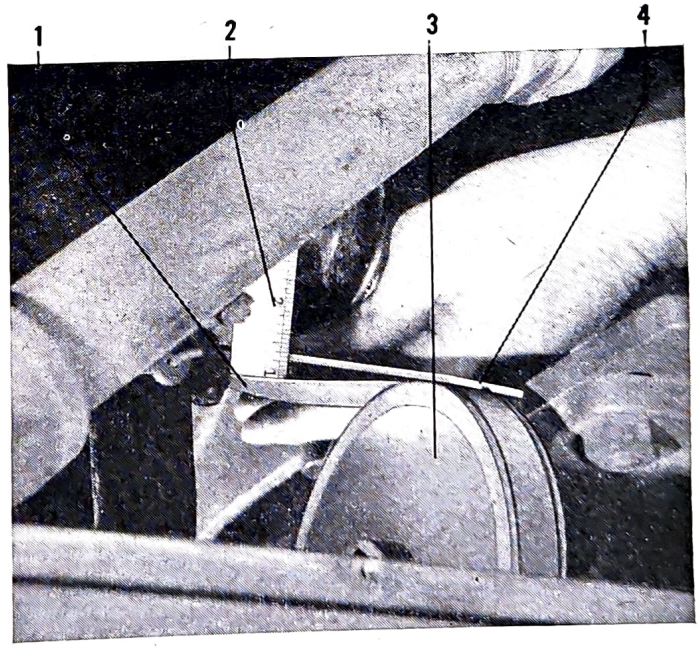
1. *Cap screw.*
2. *Drive belt.*
3. *Cap screw.*
4. *Cap screw.*
5. *Lock nut.*
6. *Power take-off chain adjusting screw.*
7. *Power take-off bracket.*
8. *Cap screw.*
9. *Power tilt drive pulley.*

Figure 64. Tilt power take-off chain adjustment.

76. Maintenance

a. Inspect Tilt Power Take-off Chain Adjustment (fig. 64). There should be no deflection in the idle side of the power tilt chain when power is applied; however the chain should not be so tight that it cannot be moved sideways on the sprocket with the fingers. If the chain is too loose or too tight, loosen the four cap screws which secure power take-off bracket on the power take-off housing. Loosen lock nut and turn power take-off chain adjusting screw *out* to tighten or *in* to loosen. Tighten the four cap screws and the lock nut.

Note. Each adjustment of the power take-off chain requires an adjustment of the drive belt, the friction wheels, and power tilt drive chain.



1. *Drive belt.*
2. *Ruler.*
3. *Intermediate pulley.*
4. *Straight edge.*

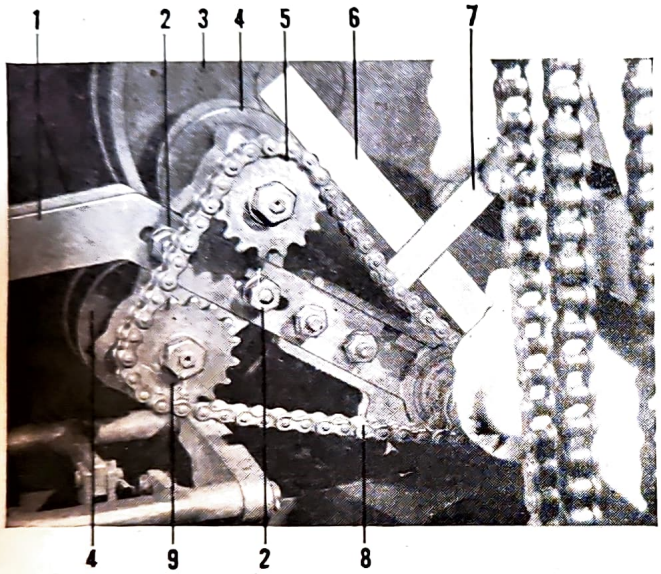
Figure 65. Testing drive belt for deflection.

b. Inspect Drive Belt Adjustment (fig. 65). Inspect drive belt for deflection by placing a straight edge across the pulleys and pressing on belt with ruler. There should be no deflection of the drive belt on the idle side when power is applied. To adjust the drive belt, loosen the four carriage bolts

which secure the tilt intermediate bearing housing and move housing *out* to tighten or *in* to loosen drive belt.

Note. Each adjustment of the drive belt requires an adjustment of the friction wheels, and power tilt drive chain.

c. Inspect Power Tilt Drive Chain Deflection (fig. 66).



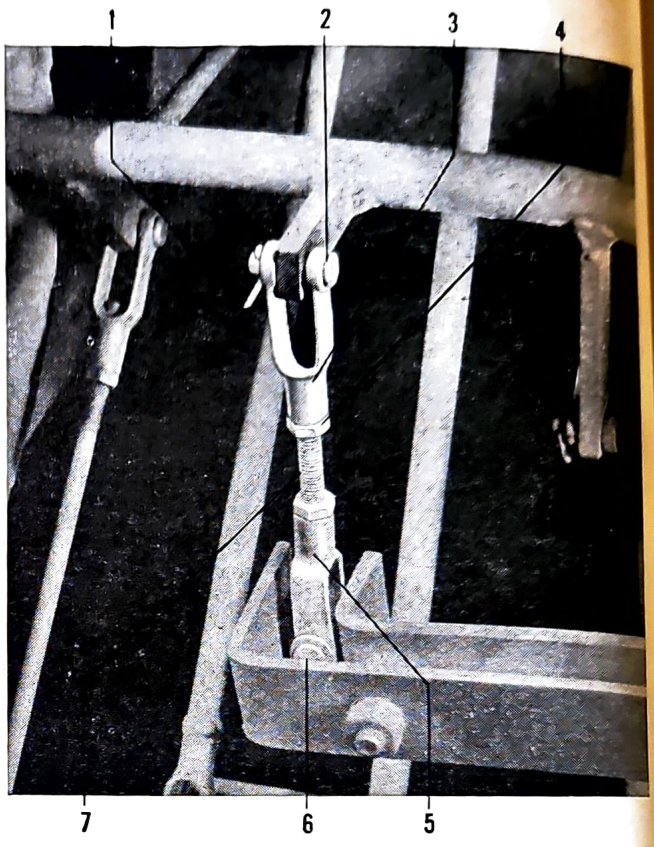
1. *Tilt control brackets.*
2. *Bolts.*
3. *Friction drum.*
4. *Friction wheels.*
5. *Friction wheel sprocket.*
6. *Straight edge.*
7. *Ruler.*
8. *Power tilt drive chain.*
9. *Friction wheel sprocket.*

Figure 66. Measuring power tilt drive chain deflection.

(1) Inspect power tilt drive chain for deflection by placing a straight edge across the sprockets and pressing on chain with a ruler. There should be no deflection in the idle side of the power tilt drive chain when power is applied; however, the chain should not be so tight that it cannot be moved sideways, with the fingers, on the sprocket.

(2) If the chain is too loose or too tight, adjust by loosening two bolts which secure the tilt control bracket. Then slide the sprocket and friction wheel assembly toward the right side of the vehicle to tighten the chain or toward the left to loosen.

Note. Each adjustment of the power tilt chain requires an adjustment of the power take-off chain, drive belt, and friction wheels.



1. *Cotter pin.*
2. *Clevis pin.*
3. *Clevis.*
4. *Lock nut.*
5. *Clevis.*
6. *Clevis pin.*
7. *Tilt control bracket rod.*

Figure 67. Adjustment of tilt control bracket rod for tilting friction wheel position.

d. Friction Wheel Adjustment (fig. 67).

Note. The friction wheels must be clear of the friction drum when the tilt control lever is in neutral.

(1) Remove cotter pins and clevis pins and loosen the lock nuts.

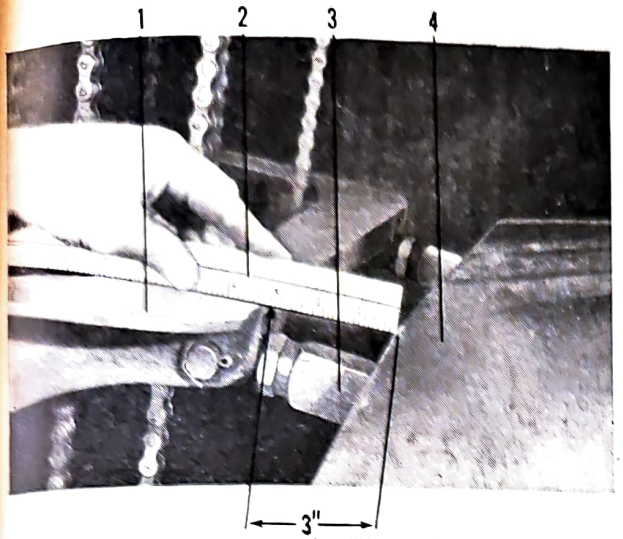
(2) Turn clevis up or down on the rod until the friction wheels are clear of the friction drum.

(3) Tighten lock nuts and install clevis and cotter pins.

Note. Any adjustment of the friction wheels must be followed by adjustments of the power take-off chain, drive belt, and power tilt drive chain.

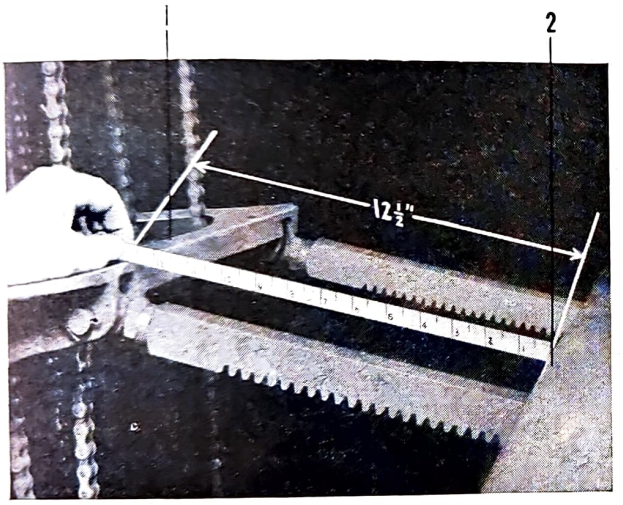
e. Adjustment of Tilt of the Masts (figs. 68 and 69).

(1) Start engine and tilt the masts until the mast bracket is 3 inches from the control housing. (See fig. 68.)



1. *Mast.*
2. *Ruler.*
3. *Tilt rack.*
4. *Control housing.*

Figure 68. Measuring amount of back tilt.



1. *Mast.*
2. *Control housing.*

Figure 69. Measuring amount of front tilt.

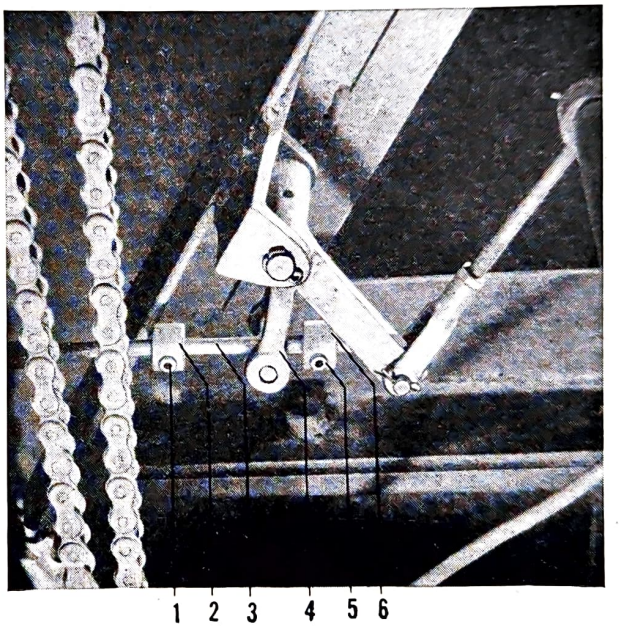
(2) If the front stop collar (fig. 70) is not resting against the tilt stop bell crank, loosen the set screw in the collar and move the front stop collar up against the bell crank.

(3) Tilt the masts forward until they are 12½ inches from the front of the control housing. If the rear stop collar (fig. 70) is not resting against the tilt stop bell crank, loosen the set screw in the collar and move the rear stop collar up against the bell crank.

f. Forcing the Tilt Control Lever. (1) When tilt control lever is forced into its "B" or back position, the lower tilt control rod may be bent.

Note. A bent lower tilt control rod will allow the brackets on the masts to which the tilt rack is fastened to hit the control housing.

(2) Inspect lower tilt control rod; if it is not straight, straighten or replace.



1. *Set screw.*
2. *Stop collar (front).*
3. *Tilt stop rod.*
4. *Stop bell crank.*
5. *Set screw.*
6. *Stop collar (rear).*

Figure 70. Adjustment for forward and back tilt.

Section XVI. LIFT MECHANISM

77. General

The lift mechanism is operated by engine power. The lift is controlled by means of a lift control lever located on the control housing in a quadrant situated to the operator's right. The load is lifted by two steel forks attached to a carriage plate which travels on steel masts. Engine power is transmitted to the carriage plate with its forks, by means of two clutches. One clutch is for lifting the load and the other clutch is for lowering the load. Engaging either clutch transmits engine power to a driving sprocket on which is a link chain. This chain passes over sprockets on the masts and the ends are secured to the carriage. The engine power therefore passes through either of the clutches to the chain and then to the carriage which carries the forks. Automatic stops prevent the load from being lifted too high or from being lowered so far as to hit the floor.

78. Maintenance

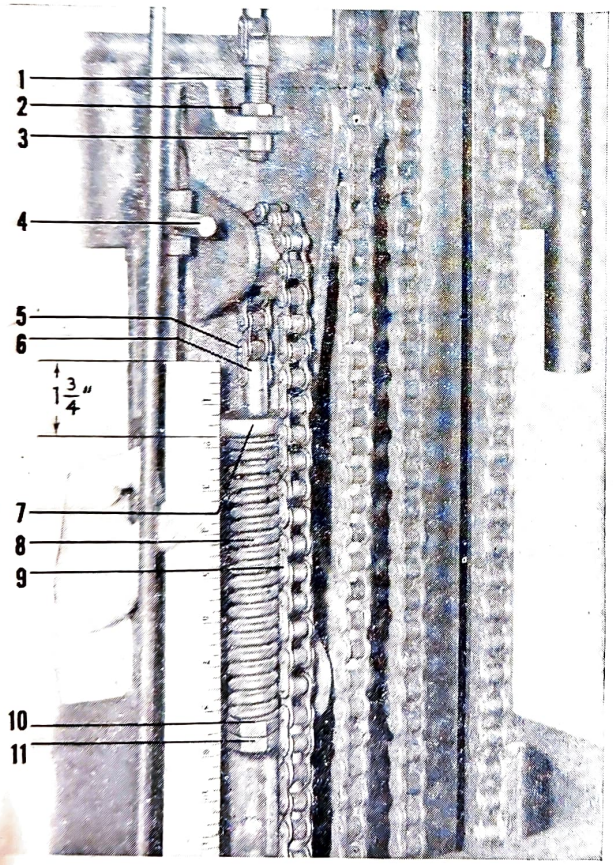
a. General. The chains on the fork lift carriage must not be too tight nor too loose. Chains which are too tight cause a loss of power and excessive chain and sprocket wear. Chains must not be so loose that they can jump a tooth on the drive sprocket.

b. Cause of Unequal Chain Lengths. (1) Chains used for heavy duty work will stretch and looseness will result.

(2) Deflection in chains is especially noticeable when the lift forks are low or near the floor or when a full load of about 2,000 pounds is being carried.

(3) When they are loose, chains may jump a tooth on the lift sprocket. This results in lack of equalization with the load all on one chain.

c. Equalize the Lift Chains (fig. 71).

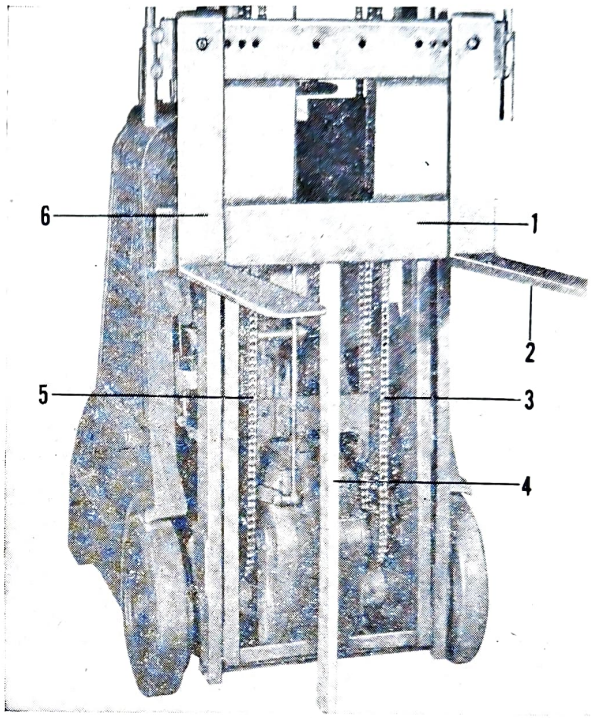


1. *Chain adjusting bolt.*
2. *Lock nut.*
3. *Nut.*
4. *Outer mast stop bracket.*
5. *Connecting link.*
6. *Chain tension spring bolt.*
7. *Mast bracket.*
8. *Chain tension spring.*
9. *Lift chain.*
10. *Retaining nut.*
11. *Jam nut.*

Figure 71. Measuring lift chains for equal tightness.

(1) Measure the distance chain tension spring bolt extends above the bracket on the back of the carriage. The bolt should extend about 1¾ inches. Repeat the procedure on the opposite chain tension spring bolt.

(2) If one bolt extends about 1 inch and the other bolt extends about 1¾ inches, the lift chains are not equalized and are out of time.



1. *Carriage.*
2. *Lift fork.*
3. *Lift chain.*
4. *Wooden stick (approx. 3 ft. long).*
5. *Lift chain.*
6. *Lift fork.*

Figure 72. Equalizing lift chains.

(3) Place a board about 3 feet long under the carriage and then start the engine. Lower the carriage slowly and carefully against the board until a snapping noise is heard. One or two short applications of power may be necessary, but extreme caution must be taken to avoid chipping sprocket teeth or breaking the chain.

(4) Lift the carriage, by engine power, off the stick and repeat the procedure in steps (1) and (2) above. If the two-chain tension spring bolts do not extend equal distances above the bracket, repeat step (3) and then step (1) above.

(5) When the chain tension spring bolts extend equal distances above the bracket, adjust these bolts so that both extend 1¾ inches above the bracket.

(6) Loosen lock nuts and turn both chain ad-

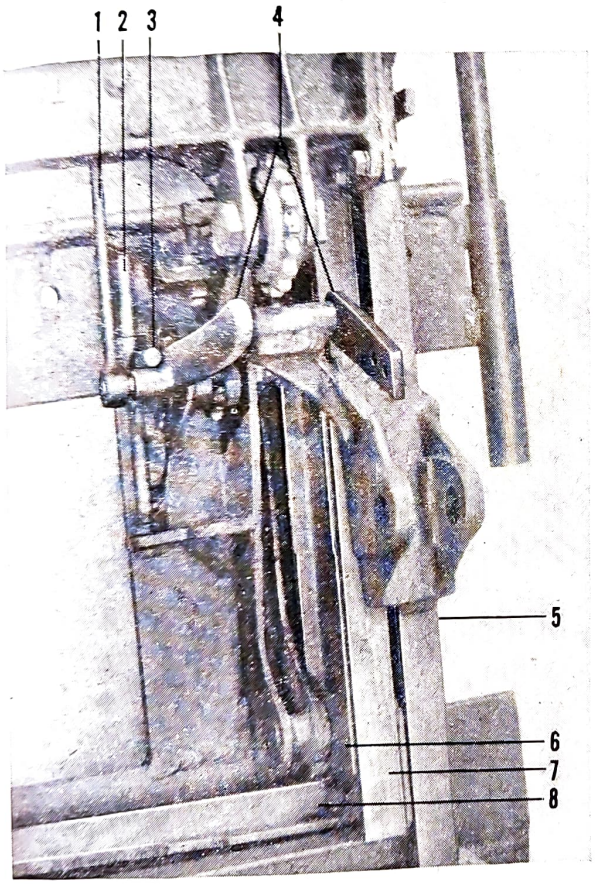
justing bolts until both chain tension spring bolts are 1¾ inches above bracket. Tighten lock nut.

Note. If chain adjusting bolts cannot be turned enough to obtain the 1¾-inch measurement on the chain tension spring bolt, remove one chain link from either or both chains.

d. To Repair One Broken Lift Chain. (1) Remove connecting link lock at chain adjusting bolt and disconnect connecting link from bolt.

(2) Remove broken link and install a new connecting link as illustrated and described in paragraph 81.

(3) Place a steel shaft or pipe under the chain tension spring. Start engine and bring carriage down



1. *Lift stop rod.*
2. *Carriage stop pin.*
3. *Carriage stop pin collar.*
4. *Lift stop bell crank.*
5. *Outer mast.*
6. *Carriage shoe.*
7. *Inner mast.*
8. *Inner mast spacer.*

Figure 73. Correct lower stop of lift.

on the shaft or pipe until the chain tension spring coils are forced together.

(4) Install chain around sprockets and install connecting link lock on chain adjusting bolt.

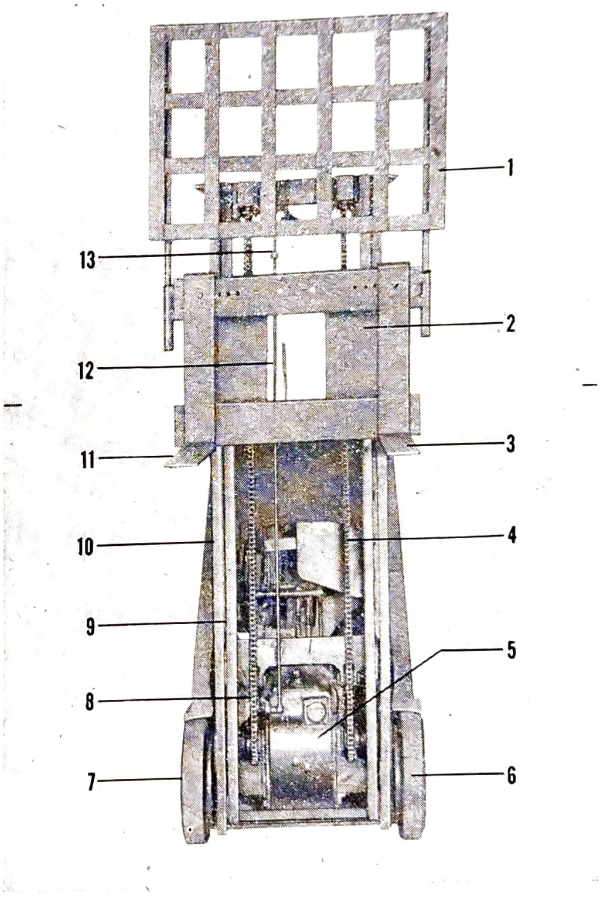
(5) Inspect chains for proper adjustment and equalization.

e. To Repair Two Broken Lift Chains. (1) Disconnect both chains in the same manner as instructed for one chain in *d*(1) above.

(2) Repair the two chains as instructed in *d*(2) above.

(3) When both chains break, the carriage will slide down the masts to the floor. Raise the carriage about 2 feet off the floor and put a piece of 2 by 4 under the carriage at about its center.

(4) Install the chains on the sprockets; the chains will be about 3 inches short and will not be able to be connected to the chain adjusting bolt.



1. *Back rest.*
2. *Carriage.*
3. *Lift fork.*
4. *Lift chain.*
5. *Drive axle housing.*
6. *Driving wheel.*
7. *Driving wheel.*
8. *Lift chain.*
9. *Inner mast.*
10. *Outer mast.*
11. *Lift fork.*
12. *Lift stop rod.*
13. *Lift stop.*

Figure 74. Front view of vehicle with carriage lifted.

(5) Hand crank engine and force carriage down on the 2 by 4 until the chains can be attached to the chain adjusting bolt. Install connecting link locks on chain adjusting bolt.

(6) Inspect chains for proper adjustment and equalization.

f. Adjust Lower Stop.

Note. The carriage stop pin collar must trip the lift stop bell crank at the same time as the carriage shoes reach the inner mast spacer

If carriage shoes are not at inner mast spacer as stop pin collar trips the lift stop bell crank, proceed as follows:

(1) Loosen set screw in carriage stop pin collar and move the collar up or down until trip is accomplished as described above.

(2) Start engine and test adjustment. If lift does not stop but goes into lift operation, adjust the lift stop link by removing cotter and clevis pins which secure lift stop link; loosen lock nut and turn clevis to shorten the rod. ***Caution:*** If rod is shortened too much it will cause the carriage to continue moving even though the lift control lever is in neutral.

(3) Start engine and test adjustment.

CHAPTER 4

AUXILIARY EQUIPMEMT

79. Auxiliary Equipment (Not Used)

Chapter 4 does not apply to this vehicle. The operation, adjustment, maintenance, removal, repair, and installation of the components are covered in other sections of this manual.

CHAPTER 5

REPAIR INSTRUCTIONS

Section I. GENERAL

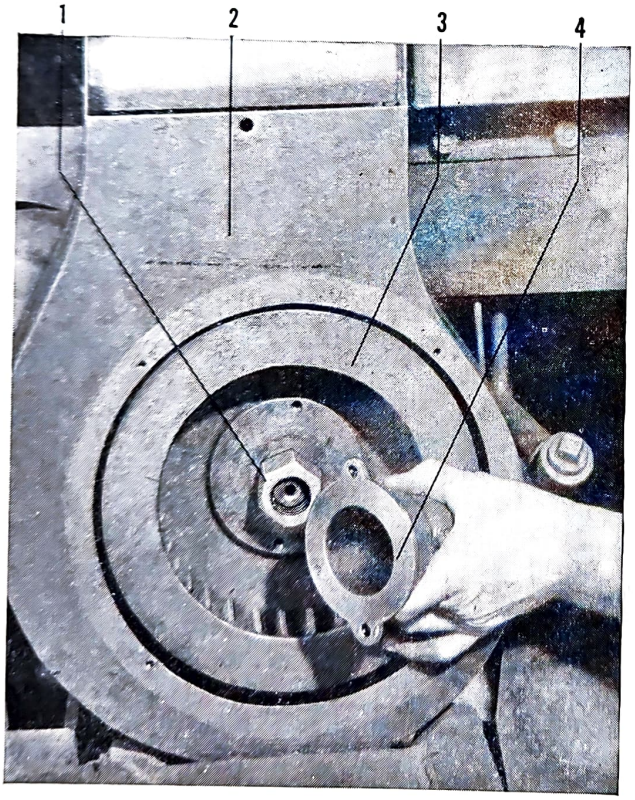
80. Scope

These instructions are for the information and guidance of the maintenance personnel responsible for the third and higher echelons of maintenance of this equipment. They contain information on the maintenance of the equipment which is beyond the scope of the tools, equipment, or supplies normally available to using organizations.

Section II. ENGINE

81. Engine Removal

a. Remove Rear Body Panel (1) Drain engine lubricant by removing drain plug in bottom of engine crankcase sump.



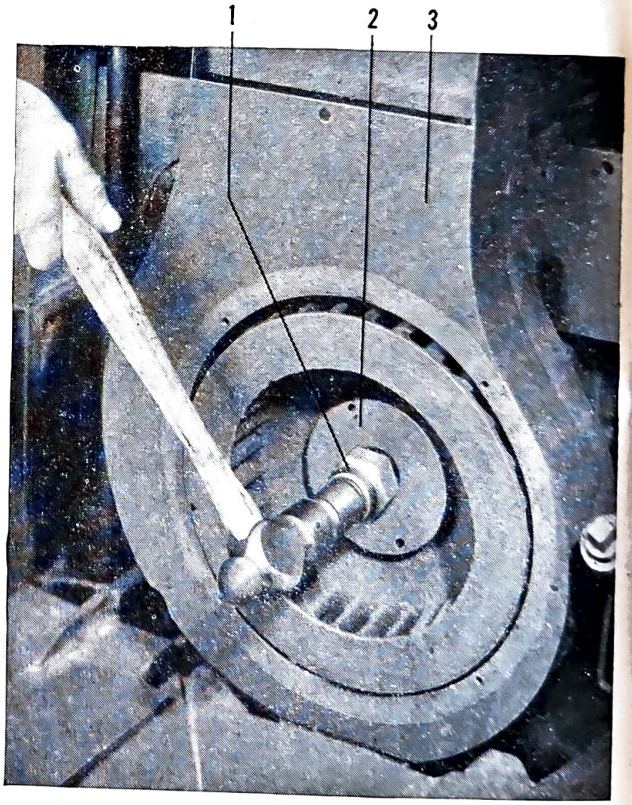
1. Flywheel lock nut. *3. Flywheel.*
2. Fan housing. *4. Starting crank adapter.*

Figure 75. Starting crank adapter.

(2) Disconnect ignition switch and spark plug wires at magneto. Disconnect choke rod at carburetor.

(3) Remove six cap screws and lockwashers which secure rear body panel to body. Unscrew gasoline tank cap. Remove the two top screws which secure the control housing.

(4) Remove cotter and clevis pins which secure the brake pedal rod to the brake pedal. Remove rear body panel assembly from vehicle.



1. Puller. *2. Flywheel.* *3. Fan housing.*

Figure 76. Pulling flywheel.

b. Remove Fan Housing Top Cover. Remove four stove bolts which secure fan housing front cover to body and remove cover. Remove one stove bolt which secures fan housing to fan housing top

cover. Remove two nuts and lockwasher securing top cover to cylinder and remove top cover.

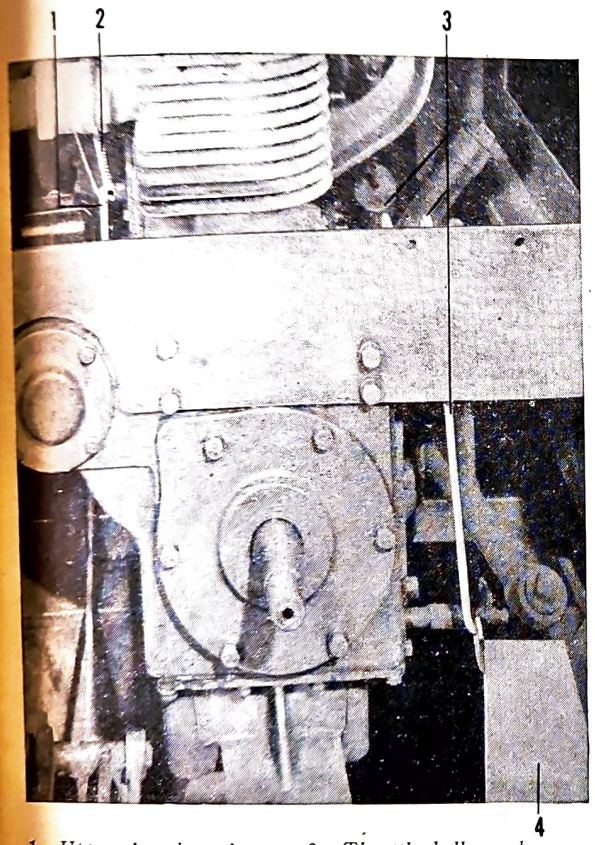
c. Remove Flywheel (figs. 75 and 76).

(1) Remove two starting crank adapter cap screws and lockwashers, and remove adapter.

(2) Remove flywheel nut and cotter pin and then remove flywheel using a puller. (See fig. 76.) Remove fan housing cap screw on right side of housing, cap screw at left top side of housing, and two cap screws and washers at bottom of housing.

d. Remove Fuel Tank. Close shut-off cock at fuel filter. Disconnect fuel line at fuel filter. Remove two bolts, nuts, and lockwashers that secure the bottom of the gasoline tank to the body. Remove cap screw securing the top of the gasoline tank to the body. Lift out gasoline tank.

e. Remove Engine Support Plate (fig. 77).



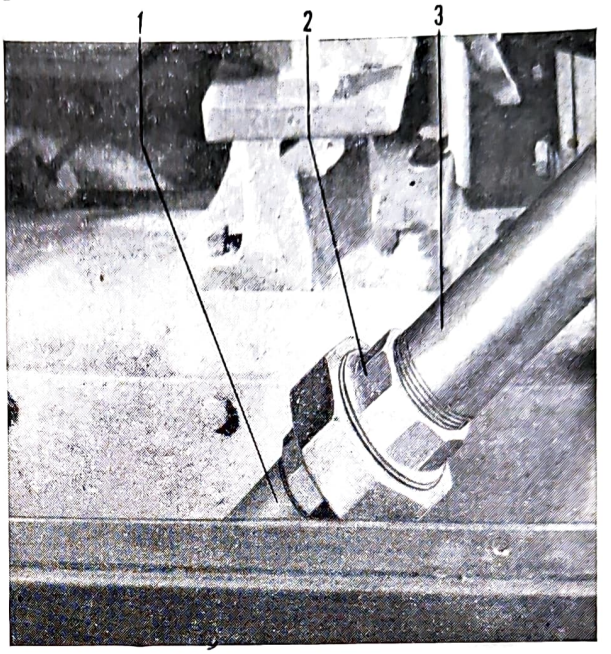
1. *Upper throttle rod.*
2. *Throttle spring.*
3. *Throttle bell crank.*
4. *Accelerator pedal.*

Figure 77. Engine support plate and accelerator linkage.

Remove two bolts, nuts, and lockwashers from each end of the engine support plate. Remove four cap screws and lockwashers securing plate to engine and remove plate.

f. Remove Carburetor. (1) Disconnect throttle bell crank from accelerator pedal by removing cotter pin and rod from pedal. Unhook throttle spring from throttle bell crank and carburetor. Remove cotter pins and unhook upper throttle rod from throttle bell crank and carburetor.

(2) Remove cap screw and lockwasher securing throttle bell crank assembly to right side of engine and remove crank assembly. Remove two cap screws and lockwashers which secure the carburetor to the carburetor elbow and remove carburetor and gasket.



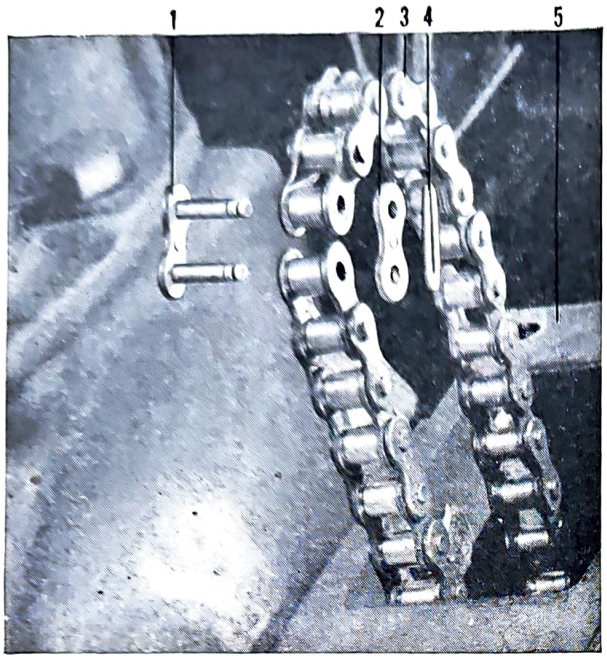
1. *Muffler pipe.*
2. *Manifold pipe union.*
3. *Manifold pipe.*

Figure 78. Manifold pipe union.

g. Remove Manifold. Remove two nuts and lockwashers which secure the manifold to the cylinder. Loosen manifold pipe union and remove manifold assembly and manifold gasket.

h. Remove Power Take-off Chain and Housing. Remove four cap screws and lockwashers which secure power take-off bracket assembly on power take-off housing. Remove drive belt. *Remove cap screws and lockwasher securing inspection cover to power take-off* housing and remove inspection cover with gasket. Remove chain link lock from chain link pins by sliding lock off pins. Push link pins down and lift link off side of chain. From opposite side of chain, pull link with pins out of chain. (See fig. 79.) Remove power take-off chain.

Note. If chain is hard to remove from sprocket, it is because the pull is being made against engine compression. Remove spark plug to relieve compression. Remove bracket assembly and gasket. Remove four cap screws and lockwashers which secure the power take-off housing on the clutch housing and remove housing and gasket.



1. *Link with pins.*
2. *Link side plate.*
3. *Power take-off chain.*
4. *Chain link lock.*
5. *Clutch housing.*

Figure 79. Disconnection of power take-off chain.

i. REMOVE ENGINE. Remove the cap screws which secure the engine crankcase to the clutch case; then jack up the clutch case about 1 inch and lift engine out of vehicle.

82. Disassembly of Engine

a. REMOVE CYLINDER HEAD. See paragraph 43.

b. REMOVE CYLINDER ASSEMBLY. See paragraph 125.

c. REMOVE MAGNETO. See paragraph 138.

d. REMOVE CRANKCASE REAR BEARING COVER. See paragraph 120.

e. DISCONNECT OIL LINE. Unscrew oil pump to crankshaft collar oil line nut at the crankshaft collar. (See fig. 80.)

f. REMOVE CRANKCASE OIL SUMP ASSEMBLY. See paragraph 100.

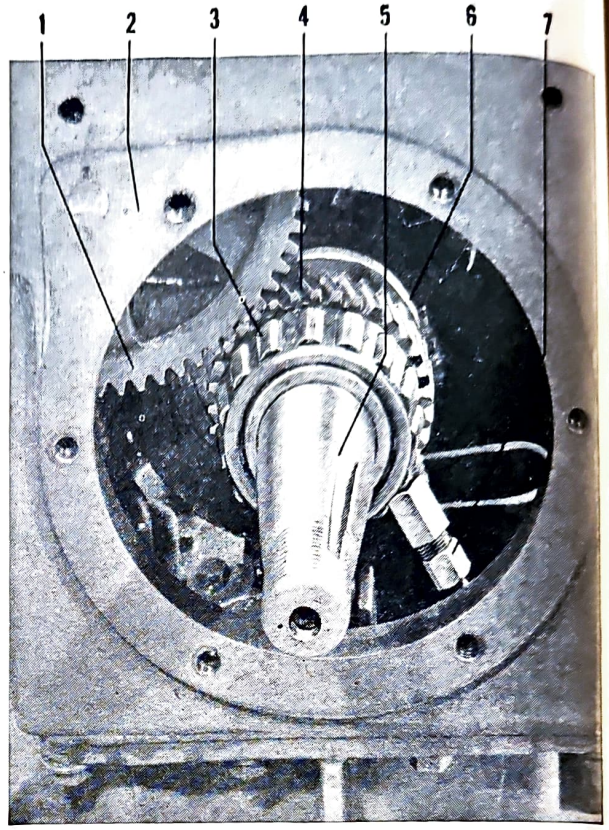
g. REMOVE CONNECTING ROD AND PISTON ASSEMBLY. See paragraph 94.

h. REMOVE CRANKCASE FRONT BEARING COVER. See paragraph 120.

i. REMOVE CRANKSHAFT ASSEMBLY. See paragraph 110.

j. REMOVE CAMSHAFT. See paragraph 116.

k. REMOVE MAGNETO TIMING GEAR. See paragraph 106.



1. *Camshaft timing gear.*
2. *Crankcase.*
3. *Crankshaft bearing cone.*
4. *Crankshaft timing gear.*
5. *Crankshaft.*
6. *Crankshaft collar.*
7. *Oil pump to crankshaft collar line.*

Figure 80. Oil pump to crankshaft collar oil line.

83. Engine Inspection and Repair

a. GENERAL. For information covering the disassembly, inspection and repair, and assembly of any one of the assemblies removed in previous paragraph (par. 82), refer to the individual paragraph in the repair section which covers the subject in detail. For example: Detailed information concerning the crankshaft can be found in paragraph 109.

b. ENGINE CRANK-CASE. (1) Inspect the tapped holes in the crankcase which accommodate the cylinder to crankcase cap screws, for indication of thread damage. Inspect the tapped holes in the crankcase where the front and rear bearing covers, oil sump, and magneto timing gear cover are mounted.

(2) Inspect the oil level cock with pipe sleeve and pipe for presence and secure mounting. Open oil level cock and clean out oil passage with compressed air.

(3) Clean the crankcase, inside and out with compressed air.

c. CRANK-CASE INSPECTION COVER. Inspect cap screws which secure crankcase inspection cover on the crankcase for thread damage. Discard crankcase inspection cover gasket. Clean oil filler pipe inside

and out and inspect weld where oil filler pipe is attached to the crankcase inspection cover. Clean inside and outside of the cover in solvent, dry cleaning.

d. Crankshaft Rear Bearing Cup. Inspect crankshaft rear bearing cup for ridges, scores, or looseness in crankcase. Replace cup if damaged or loose.

e. Magneto Drive Gear Bushing. Inspect magneto drive gear bushing for scoring. Insert magneto drive gear shaft in bushing; if fit between shaft and bushing is loose, replace bushing. The shaft clearance should be .003-inch.

84. Engine Assembly

a. Install Magneto Timing Gear. See paragraph 108.

b. Install Camshaft. See paragraph 118.

c. Install Crankshaft Assembly. See paragraph 114.

d. Install Crankcase Front Bearing Cover. See paragraph 124.

e. Install Connecting Rod and Piston Assembly. See paragraph 98.

f. Install Crankcase Oil Sump Assembly. See paragraph 104.

g. Connect Oil Line. Screw oil pump to crankshaft collar oil line on the crankshaft collar. See figure 80.

h. Install Crankcase Rear Bearing Cover. See paragraph 124.

i. Install Magneto. See paragraph 63.

j. Install Cylinder Assembly. See paragraph 92.

k. Install Cylinder Head. See paragraph 43.

85. Engine Installation

a. Install Engine in Vehicle. Install engine so that cap screw holes in engine crankcase and clutch aline. Install cap screws which secure engine crankcase to clutch case.

b. Install Power Take-off Chain and Housing. (1) Install power take-off housing and new gasket on clutch housing and secure with four cap screws and lockwashers. Install power take-off bracket assembly and gasket on power take-off housing, and secure with four cap screws and lockwashers. Install drive belt.

(2) Install power take-off chain around sprockets in clutch. Connect ends of chain by, installing link with pins through ends of chain; from opposite side of chain, install link on pins and secure by sliding chain pin lock on pins.

Note. If ends of chain are difficult to connect, it is because the pull is being made against engine compression. Remove spark plug to relieve compression. Install inspection cover with gasket on power take-off housing, secure with cap screws and lockwashers.

c. Adjust Power Take-off Chain. See paragraph 78.

d. Install Manifold (fig. 46). Install manifold assembly and new gasket on cylinder. Connect manifold pipe to muffler pipe at manifold pipe union. Install two nuts and lockwashers which secure manifold to cylinder.

e. Install Carburetor. Install carburetor with gasket and carburetor elbow and secure with two cap screws and lockwashers. Install throttle bell crank assembly; install cap screw and lockwasher which secures crank to right side of engine. Hook upper throttle rod on throttle bell crank and carburetor and secure with cotter pins. Hook throttle spring on throttle bell crank and carburetor. Connect throttle bell crank to accelerator pedal and secure with cotter pin.

f. Install Engine Support Plate (fig. 77). Install engine support plate and secure to engine with four cap screws and lockwashers. Connect both ends of plate to body with two bolts, nuts, and lockwashers.

g. Install Gasoline Tank (fig. 77). Install gasoline tank and secure top of tank to the body with one cap screw and lockwasher. Secure bottom bracket on tank to body with two bolts, nuts, and lockwashers. Connect fuel line to fuel filter. Open fuel shut-off cock at fuel filter.

h. Install Flywheel (fig. 76). Install fan housing and secure with two cap screws and washers at bottom of housing; cap screw at left top side of housing; and cap screw at right side of housing. Install flywheel and flywheel nut. Turn nut up tight and secure with cotter pin. Install starting crank adapter and secure with two cap screws and lockwashers.

i. Install Fan Housing Top Cover (fig. 76). Install fan housing top cover and secure to cylinder with two nuts and lockwashers. Install stove bolt which secures fan housing to fan housing top cover. Install fan housing front cover and secure with four stove bolts.

j. Install Rear Body Panel (fig. 50). Install rear body panel assembly and secure with six cap screws and lockwashers. Attach brake pedal rod to brake pedal and secure with clevis and cotter pins. Install the two top screws which secure the control housing. Install fuel tank cap. Connect choke rod to carburetor by hooking it into place. Connect ignition switch and spark plug wires. Fill engine with lubricant.

k. Tune-up Engine. Perform engine tune-up. (See paragraph 40.)

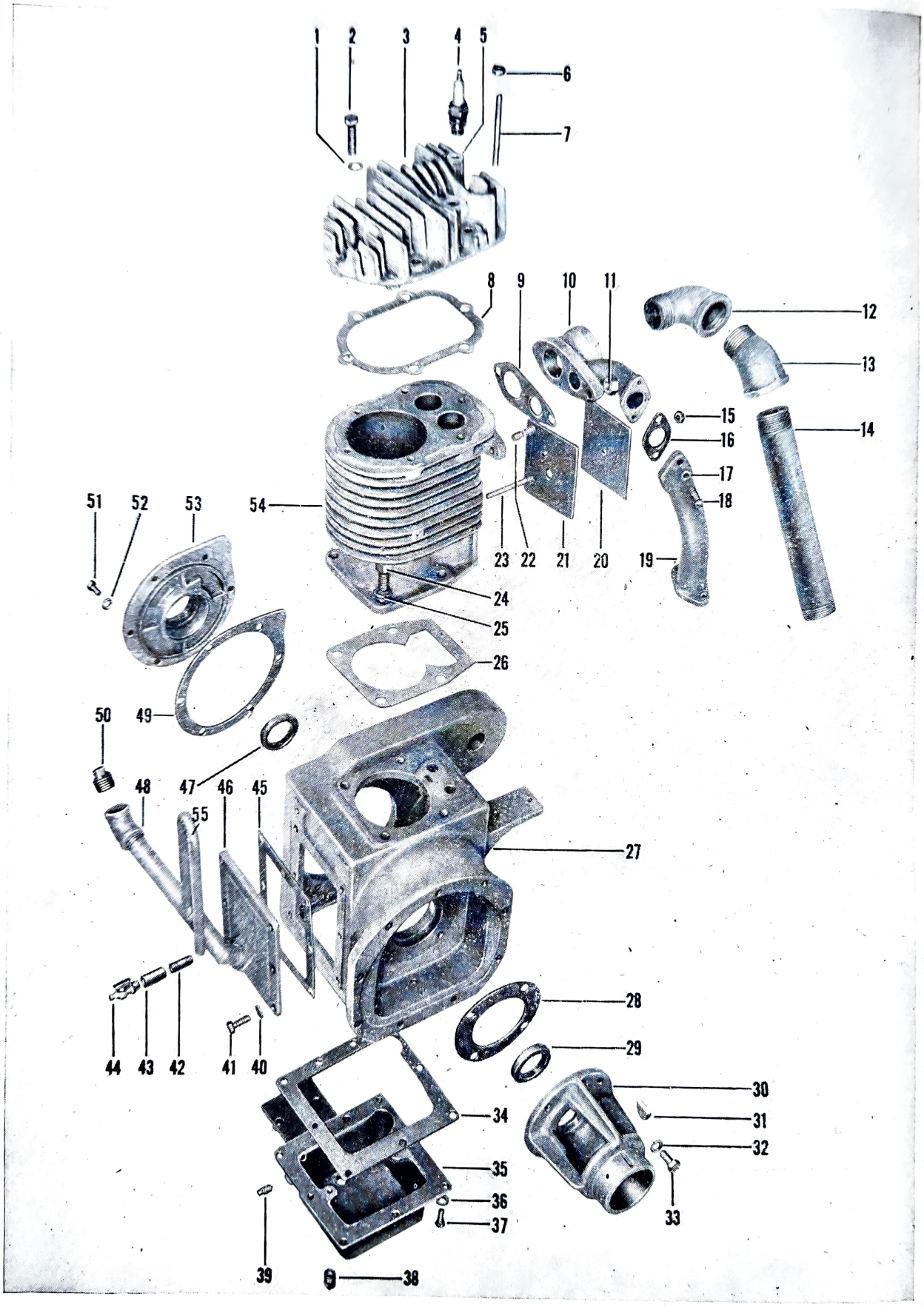


Figure 81. Crankcase, cylinder, cylinder head, manifolds, and oil sump.

Legends for figure 81.

1. *Cylinder head flat washer.*
2. *Cylinder head cap screw.*
3. *Cylinder head.*
4. *Spark plug.*
5. *Spark plug gasket.*
6. *Flywheel fan housing top cover nut.*
7. *Flywheel fan housing top cover stud.*
8. *Cylinder head gasket.*
9. *Manifold gasket.*
10. *Manifold.*
11. *Manifold nut.*
12. *90° exhaust elbow.*
13. *45° exhaust elbow.*
14. *Manifold pipe.*
15. *Valve lifter cover nut.*
16. *Carburetor pipe to manifold gasket.*
17. *Lockwasher.*
18. *Cap screw.*
19. *Carburetor to manifold pipe.*
20. *Valve lifter cover.*
21. *Valve lifter cover gasket.*
22. *Manifold stud.*
23. *Valve lifter cover stud.*
24. *Cylinder hold-down cap screw.*
25. *Lockwasher.*
26. *Cylinder to crankcase gasket.*
27. *Crankcase.*
28. *Crankcase front bearing cover gasket.*
29. *Front oil seal.*
30. *Front bearing cover.*
31. *Front bearing cover key.*
32. *Lockwasher.*
33. *Screw.*
34. *Oil sump gasket.*
35. *Oil sump.*
36. *Lockwasher.*
37. *Cap screw.*
38. *Crankcase drain plug.*
39. *Oil sump plug.*
40. *Lockwasher.*
41. *Cap screw.*
42. *Oil level cock nipple.*
43. *Oil level cock sleeve.*
44. *Oil level cock.*
45. *Crankcase inspection cover gasket.*
46. *Crankcase inspection cover.*
47. *Rear oil seal.*
48. *Oil filler pipe elbow.*
49. *Rear bearing cover gasket.*
50. *Oil filler plug.*
51. *Screw.*
52. *Lockwasher.*
53. *Rear bearing cover.*
54. *Cylinder.*
55. *Crankcase breather tube.*

Section III. CYLINDER HEAD AND VALVE MECHANISM

86. General

The valve mechanism consisting of valves and springs plus lifter assemblies and the cylinder head can be removed with the cylinder.

87. Maintenance

a. Valve Clearance Adjustment (fig. 48). Adjust intake and exhaust valve clearance as instructed in paragraph 40.

b. Maintenance. Inspect valve springs for dirt, rust, scale, or sludge. Clean dirt from cylinder head, valve mechanism, and piston head, using solvent, dry cleaning. Wipe clean and dry. Replace gasket.

88. Removal

a. Rear Body Panel. Remove rear body panel assembly. See paragraph 81.

b. Remove Fan Housing Top Cover. See paragraph 81.

c. Remove Carburetor. See paragraph 51.

d. Remove Manifold. See paragraph 41.

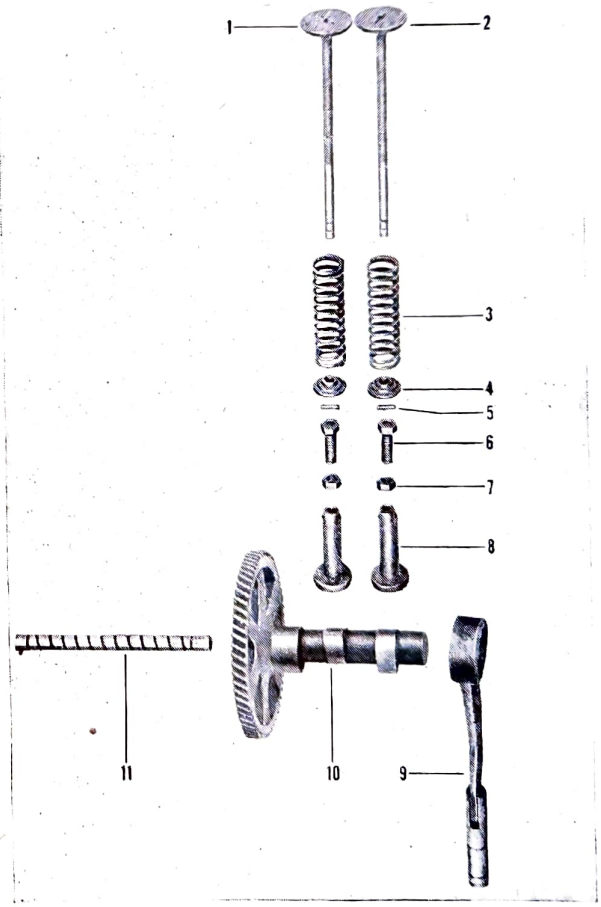
e. Remove Crankcase Oil Sump. See paragraph 46.

f. Remove Piston and Connecting Rod. See paragraph 94.

g. Remove Cylinder Assembly. Remove cap screws and lockwashers which secure cylinder to crankcase and remove cylinder assembly and gasket.

89. Disassembly

a. Remove Cylinder Head. Remove cap screws and washers which secure cylinder head to cylinder and remove cylinder head and gasket.



1. *Intake valve.*
2. *Exhaust valve.*
3. *Valve spring.*
4. *Valve spring retainer.*
5. *Valve spring retainer lock pin.*
6. *Valve lifter adjusting screw.*
7. *Valve lifter adjusting screw lock nut.*
8. *Valve lifter.*
9. *Oil pump connecting rod with plunger.*
10. *Cam with gear.*
11. *Cam and gear shaft.*

Figure 82. Cams, gear, shaft and valves.

b. Remove Valves. Using a valve spring compressor tool, compress the intake valve spring and remove the valve spring retainer lock from valve stem. Remove compressor tool and remove the intake valve from top of cylinder. Remove the valve springs and valve spring retainers from the cylinder. Repeat the procedure on the exhaust valve.

c. Remove Valve Lifters. Unscrew valve lifter adjusting screw lock nuts and valve lifter adjusting screw from the valve lifters. Remove camshaft. (See par. 116.) Reach inside of the crankcase and remove the valve lifters.

90. Repair

a. Cylinder. To compensate for normal wear, grind the valve seats in the cylinder head. Since the valve guides must be used as pilots when grinding valve seats, thoroughly clean the guides before grinding the valve seats. Use a valve guide cleaner. Inspect cylinder for out-of-round or taper with a cylinder gauge or inside micrometers. If taper or out-of-round exceeds .003 inch, recondition cylinder bore.

b. Valve Mechanism. Test valve springs for tension in valve spring testing machine. Test must show 90-pound tension. Reface burned or pitted valves in a valve refacing machine. Remove no more material from the valve face than necessary to remove the pitted or burned portion. After refacing the valves, inspect for identical angles between valve seat and valve face using a very light tint of prussian blue. If a full seat width of contact around the entire circle of the seated valve is not shown, the angles do not match. ***Caution:*** *The correction must be made on the valve seat and not on the valve.*

91. Assembly

a. Install Valve Lifters (fig. 82). Install valve lifters from inside of crankcase. Install camshaft. (See par. 118.) Install valve lifter adjusting screw lock nuts and valve lifter adjusting screw into valve lifters.

b. Install Valves (fig. 82). Install intake valve through the top of the cylinder and slide valve spring and valve spring retainer on valve stem. Compress valve spring with a valve spring compressor tool and insert valve spring retainer lock pin through valve stem. Repeat procedure on exhaust valve.

c. Adjust Valve Lifters (par. 44). Inspect camshaft timing. (See par. 118.)

d. Install Cylinder Head (fig. 82). Using a new cylinder head gasket, install gasket and cylinder head on cylinder. Install cylinder head cap screws and washers. Tighten in sequence shown in figure 47. Draw all screws down to a 70 foot-pound torque with a torque wrench. Go over each screw a second time as a final check.

92. Installation

a. Install Cylinder Assembly. Using new cylinder gasket, install gasket and cylinder on crankcase and secure with cap screws and washers.

b. Install Piston and Connecting Rod. See paragraph 98.

c. Install Crankcase Oil Sump. See paragraph 46.

d. Install Manifold. See paragraph 41.

e. Install Carburetor. See paragraph 51.

f. Install Fan Housing Top Cover. See paragraph 85.

g. Install Rear Body Panel. See paragraph 85.

Legends for figure 83.

1. *Compression ring.*
2. *Oil ring.*
3. *Piston.*
4. *Piston pin.*
5. *Piston pin snap ring.*
6. *Connecting rod.*
7. *Connecting rod bolt.*
8. *Crankshaft.*
9. *Crankshaft timing gear key (Woodruff).*
10. *Crankshaft collar.*
11. *Crankshaft timing gear.*
12. *Crankshaft bearing cone.*
13. *Crankshaft bearing cup.*
14. *Flywheel and fan assembly.*
15. *Flywheel key.*
16. *Flywheel nut.*
17. *Starting crank adapter.*
18. *Screw.*
19. *Washer.*
20. *Cotter pin.*
21. *Nut.*
22. *Connecting rod cap.*
23. *Connecting rod shim.*
24. *Piston pin bushing.*

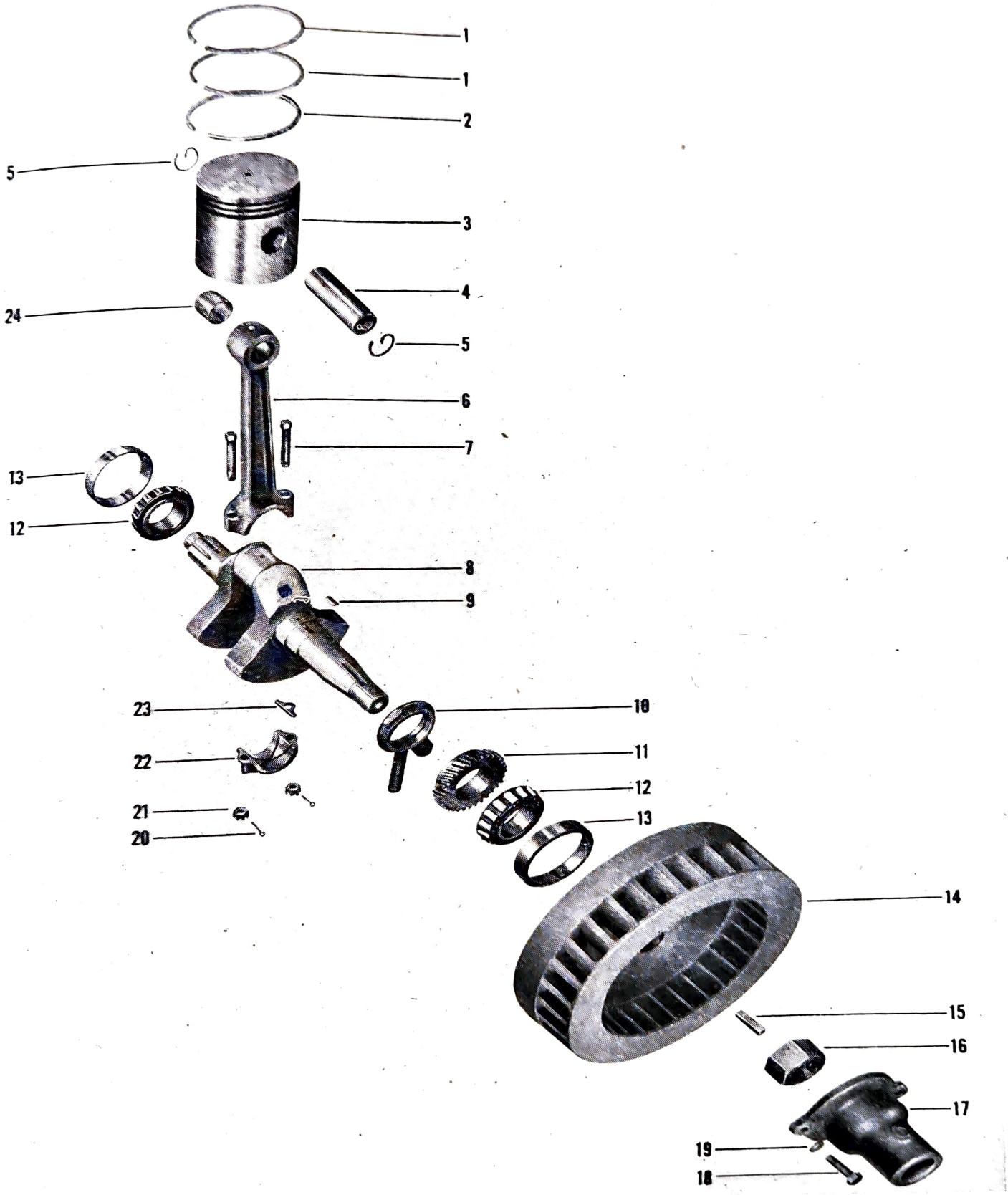


Figure 83. Engine crankshaft, flywheel, piston and connecting rod.

Section IV. CONNECTING ROD AND PISTON

93. General

The piston which has two compression rings and one oil ring, is secured to the connecting rod by a piston pin which is held in place by snap rings. The connecting rod has a replaceable piston pin bushing and a babbitt bearing at the crankshaft end. This babbitt bearing is cast in the connecting rod.

94. Removal

Remove cylinder head (par. 43) and oil sump (par. 46). Remove cotter pins and connecting rod bolt nuts and remove bolts from cap and rod. Remove cap and shims.

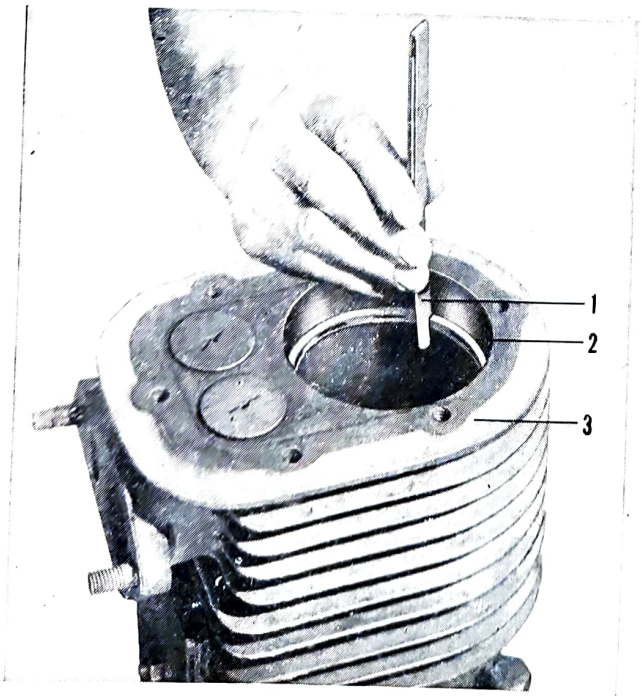
Note. If the same connecting rod, cap, and crankshaft are to be reused, mark the rod and cap for identification in reassembly. Use the same number of shims on each side. Remove piston with connecting rod from top of cylinder.

95. Disassembly

Remove compression rings and oil ring. Remove piston pin snap rings and remove piston pin from piston and connecting rod.

96. Repair and Inspection

a. Using an alignment gauge, inspect connecting rod for parallel alignment with the piston. The running clearance of the piston pin in the piston pin bushing should be a press fit with the hand; the pin clearance in the piston pin bore should be a press fit with the hand, after piston has been heated in boiling water. If the clearance between the piston pin and bushing is excessive, ream the bushing and the piston to fit a 0.005-inch oversize piston pin to the clearances specified above.



1. Feeler gauge. 2. Piston ring. 3. Cylinder.

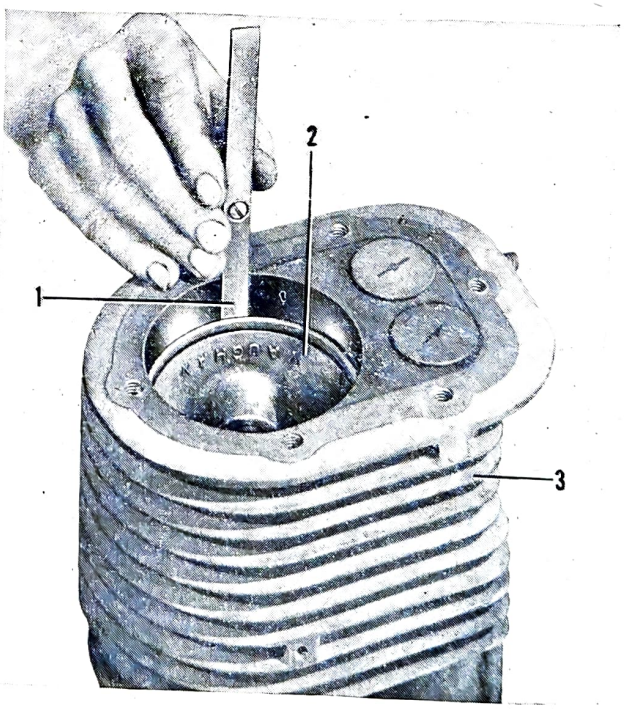
Figure 84. Verifying piston ring gap.

b. Inspect the connecting rod bearings for wear or damage. If worn, scored, or damaged, replace the connecting rod with cap. Inspect crankshaft; if the crankshaft throw (where the connecting rod fits) is scored or out of round, replace crankshaft.

c. The running clearance between the connecting rod bearings and the crankshaft should be 0.005-inch.

d. Clean the piston, particularly the piston ring grooves.

e. Install piston ring in cylinder, and use piston to force the ring down into lower portion of cylinder. This squares the piston ring in the cylinder. Remove piston and inspect piston ring gap with a feeler gauge. The piston ring gap should be 0.007-inch.



1. Feeler gauge. 2. Piston. 3. Cylinder.

Figure 85. Verifying piston fit in cylinder.

f. The clearance between the piston and the cylinder should be 0.004-inch. Insert a 12-inch long feeler blade which is 0.0035-inch thick between the piston and cylinder. The feeder blade should be removable at a scale reading of 2 to 7 pounds.

97. Assembly

a. INSTALL PISTON (fig. 83). The piston pin should be at room temperature (70° F. approx-

imately) and coated with lubricant. Heat piston in boiling water to approximately 200° Fahrenheit. Position connecting rod in piston so that bushing is aligned with the piston pin hole in piston. With piston still hot, press piston pin into place with palm of hand. Thoroughly dry piston with compressed air.

b. Install Piston Pin Snap Rings. These rings should be installed at ends of piston pin. Using a piston ring expander, install the oil control ring and two compression rings.

98. Installation

a. Install Piston and Connecting Rod (fig. 83). Immerse piston assembly in OE and, using a piston ring compressor tool, install piston and connecting rod in the cylinder.

b. Install Connecting Rod Cap (fig. 83). Be sure bearing surfaces are clean. Coat the surfaces with OE. Install connecting rod on crankshaft. Place connecting rod cap on the rod. Install connecting rod shims so that clearance between connecting rod and crankshaft is 0.003-inch. (See par. 97.) Install connecting rod bolts and nuts. Turn nuts up to 40 foot-pound torque. Hand crank the engine to test for smooth and free operation of crankshaft. Install cotter pins.

c. Inspect Timing of Camshaft. See paragraph 118.

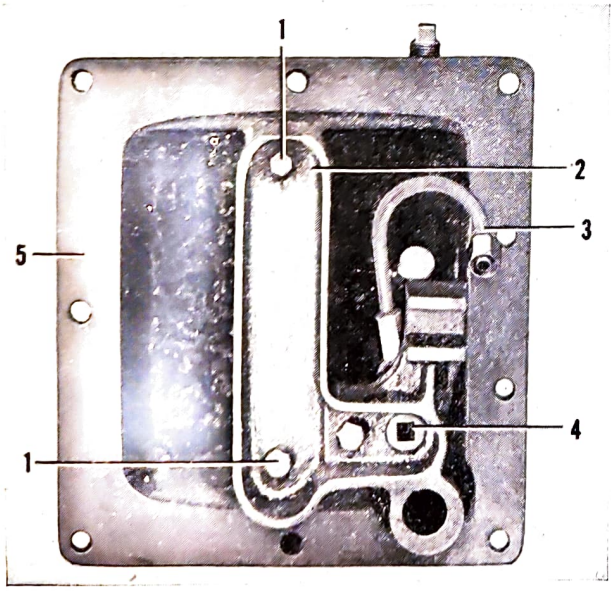
Section V. CRANKCASE OIL SUMP AND LUBRICATING OIL PUMP

99. General (fig. 86)

The plunger type oil pump is operated by a connecting rod, one end of which has an eye which slips onto a cam on the camshaft. The opposite end of the connecting rod is hinged to a plunger which operates in a cylinder as a pump. A floating intake screen, at the intake of the pump, is located below the surface of the crankcase oil level where it picks up the cleanest oil for circulation.

100. Removal (fig. 86)

See paragraph 45.



1. *Cap screws.*
2. *Oil pump body.*
3. *Pump to crankshaft collar oil line.*
4. *Spring retainer plug.*
5. *Crankcase oil sump.*

Figure 86. Engine crankcase oil sump assembly.

101. Disassembly

a. Remove spring retainer plug from oil pump relief valve and remove spring and ball check.

b. Remove three cap screws and lockwashers which secure oil pump body to crankcase oil sump and remove body and oil screen.

c. Remove pump to crankshaft collar oil line and fitting from oil pump body.

102. Inspection and Repair

Clean the oil screen thoroughly in solvent, dry cleaning. Replace screen if damaged. Clean the crankcase oil sump and oil pump body in solvent, dry cleaning. Blow out pump to crankshaft collar oil line with compressed air. See that all oil passages are clear and blow out with compressed air.

103. Assembly (fig. 87)

a. Install pump to crankshaft collar oil line and fitting on oil pump body.

b. Install oil screen in crankcase oil sump. Position oil pump body on the sump so that end of oil pump cylinder is inside of oil screen. Secure oil pump body to sump with three cap screws and lockwashers.

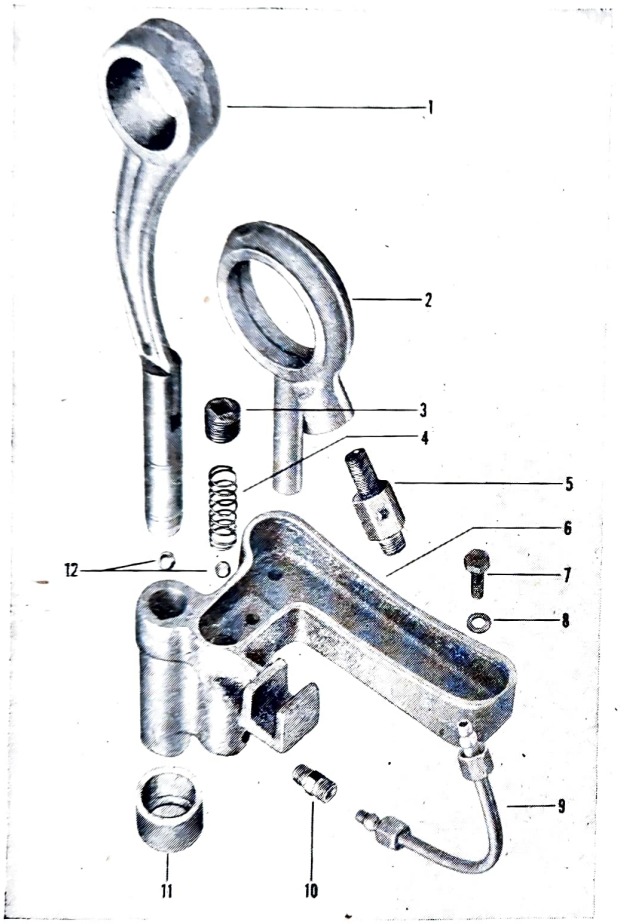
c. Install ball check and pump spring in oil pump relief valve and install spring retainer plug.

d. Place ball check in the oil pump cylinder inlet.

104. Installation

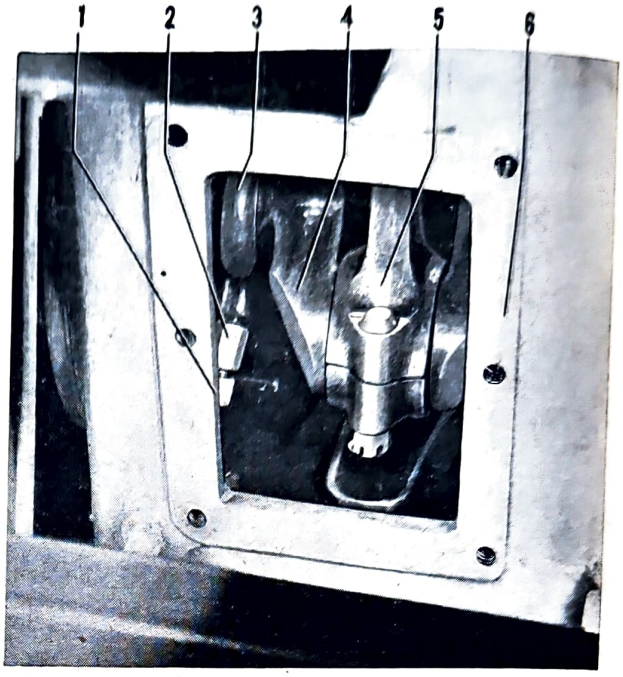
See paragraph 46.

Note. Remove crankcase inspection plate (fig. 81) and rotate engine by hand several times. See that oil is being forced out around the connecting rod.



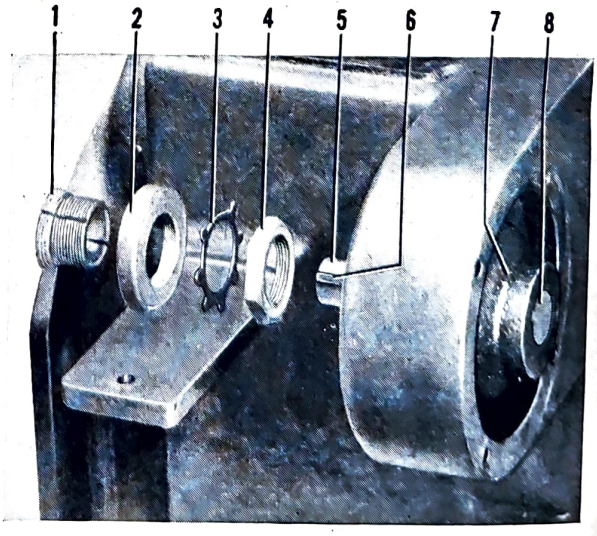
1. *Connecting rod with plunger assembly.*
2. *Crankshaft collar.*
3. *Spring retainer plug.*
4. *Spring.*
5. *Check valve.*
6. *Oil pump body.*
7. *Cap screw.*
8. *Lockwasher.*
9. *Oil line.*
10. *Fitting.*
11. *Oil screen.*
12. *Ball checks.*

Figure 87. Engine oil pump and oil screen.



1. *Oil pump to crankshaft collar oil line fitting.*
2. *Oil check valve.*
3. *Crankshaft collar.*
4. *Crankshaft.*
5. *Connecting rod.*
6. *Crankcase.*

Figure 88. Inspection of oil pump action.



1. *Compression nut.*
2. *Magneto coupling.*
3. *Lockwasher.*
4. *Lock nut.*
5. *Magneto drive shaft.*
6. *Key.*
7. *Magneto timing gear.*
8. *Magneto drive shaft.*

Figure 89. Removal of magneto timing gear.

Section VI. MAGNETO TIMING GEAR

105. General

The magneto timing gear is mounted in the left side of the crankcase on a drive shaft. This gear is meshed with the camshaft gear and the magneto is coupled to the drive shaft with an adjustable coupling. A removable bushing is pressed into the crankcase for the drive shaft.

106. Removal (fig. 89)

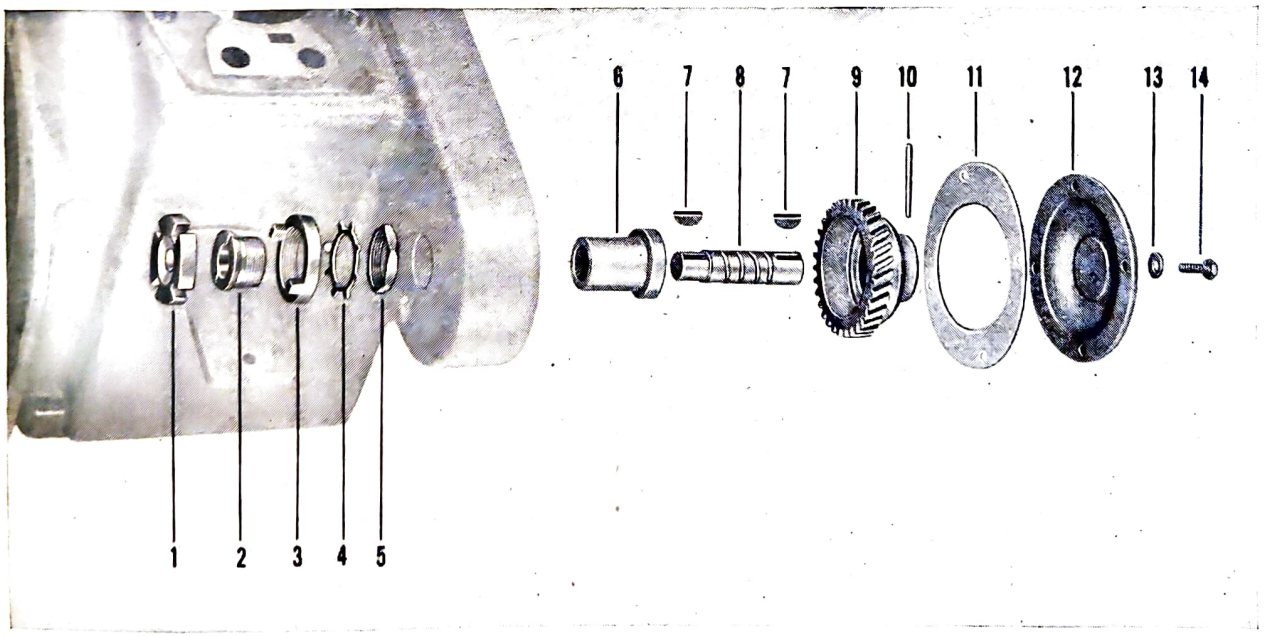
Remove cap screws and lockwashers securing timing gear cover and remove cover and gasket. Bend tangs of lockwasher off the lock nut. Loosen lock nut and unscrew compression nut. Remove magneto coupling, lockwasher, and lock nut. Remove key from magneto drive shaft and remove magneto timing gear with magneto drive shaft from crankcase. Drive out pin which holds timing gear on magneto drive shaft. Press gear off shaft.

107. Inspection and Repair

Replace magneto timing gear if teeth are chipped. Inspect keyway in magneto drive shaft; replace shaft and key if keyway is damaged. Inspect compression nut, magneto coupling, and lock nut for damaged threads; replace if necessary. See that drive shaft has a clearance of .002 inch in bushing; if clearance exceeds .003 inch, replace bushing and ream or hone to .002 inch.

108. Installation (fig. 91)

Install magneto timing gear on magneto drive shaft and drive magneto timing gear pin through gear and shaft. Install gear and shaft in crankcase and inspect fit of shaft in bushing. (See par. 107.) Install key in magneto drive shaft; install magneto coupling, lockwasher, and lock nut. Install compression nut and tighten lock nut. Bend tangs of lockwasher on lock nut. Install timing gear cover and new gasket, secure with cap screws and lockwashers.



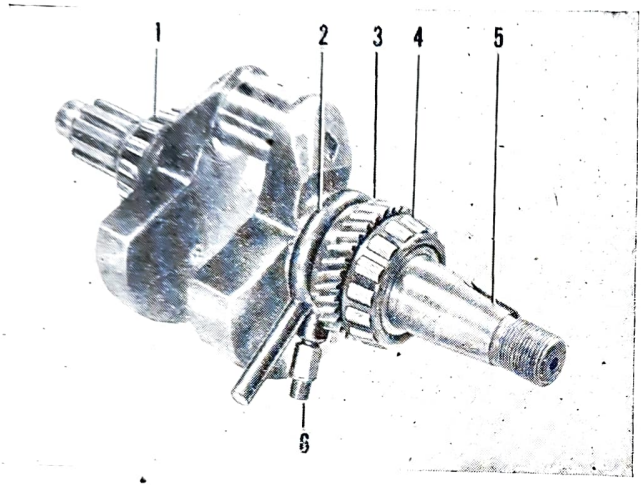
1. *Magneto coupling fibre disk.*
2. *Compression nut.*
3. *Magneto coupling.*
4. *Lockwasher.*
5. *Lock nut.*
6. *Drive shaft bushing.*
7. *Drive shaft Woodruff key.*
8. *Magneto drive shaft.*
9. *Timing gear.*
10. *Timing gear pin.*
11. *Timing gear cover gasket.*
12. *Timing gear cover.*
13. *Washer.*
14. *Cap screw.*

Figure 90. Magneto timing gear and drive coupling.

Section VII. CRANKSHAFT ASSEMBLY

109. General

The crankshaft assembly consists of the crankshaft, the crankshaft timing gear, crankshaft oil collar, and the crankshaft roller bearing cones. The crankshaft is supported by roller bearings. (See fig. 91.) The crankshaft collar is connected to the pressure lubrication system for lubrication of the crankshaft and connecting rod bearings. The crankshaft timing gear drives the camshaft and magneto gears.



1. *Crankshaft front bearing cone.*
2. *Crankshaft collar.*
3. *Crankshaft timing gear.*
4. *Crankshaft rear bearing cone.*
5. *Crankshaft.*
6. *Oil check valve.*

Figure 91. Crankshaft assembly.

110. Removal

a. REMOVE CRANKCASE REAR BEARING COVER. See paragraph 120.

b. DISCONNECT OIL LINE. Unscrew oil pump to crankshaft collar oil line nut at the crankshaft collar.

c. REMOVE CRANKCASE OIL SUMP ASSEMBLY. See paragraph 46.

d. REMOVE CRANKCASE FRONT BEARING COVER. See paragraph 120.

e. REMOVE CYLINDER HEAD. See paragraph 43.

f. REMOVE PISTON AND CONNECTING ROD ASSEMBLY. See paragraph 94.

g. REMOVE CRANKSHAFT ASSEMBLY FROM CRANKCASE.

Note. In some cases the tooth of the cam gear and the two teeth of the crankshaft gear are marked to give top dead center position. If the teeth are not marked, use a prick punch and mark them before disassembly.

111. Inspection and Repair

a. Inspect rollers of crankshaft bearings by rotating bearings with the fingers and observing for uneven action. See that rollers are secure in the retainer. If rollers are chipped or scored replace cones and cups.

b. See that crankshaft collar oil holes are open and that collar is in good condition.

c. Inspect crankshaft timing gear for chipped or scored teeth. See that timing gear is tight on crankshaft.

112. Disassembly (fig. 83)

Press crankshaft bearing and timing gear off the crankshaft. Remove crankshaft collar and crankshaft timing gear key. Press crankshaft bearing off opposite end of crankshaft. Remove check valve from crankshaft collar.

113. Assembly

Press crankshaft front bearing on crankshaft. Be certain bearing is pressed against shoulder on crankshaft. Install crankshaft collar and screw check valve into the collar. Install crankshaft timing gear over crankshaft timing gear key in crankshaft. Press crankshaft rear (flywheel end) bearing on crankshaft. Be certain bearing is pressed against shoulder on crankshaft.

114. Installation

a. INSTALL CRANKSHAFT ASSEMBLY. Install this assembly in crankcase and time camshaft timing gear with crankshaft timing gear. (See par. 118.)

b. INSTALL CRANKCASE FRONT BEARING COVER. See paragraph 124.

c. CONNECT OIL LINE. Screw oil pump to crankshaft collar oil line nut on crankshaft collar.

d. INSTALL PISTON AND CONNECTING ROD ASSEMBLY. See paragraph 98.

e. INSTALL CRANKCASE REAR BEARING COVER. See paragraph 124.

f. INSTALL CYLINDER HEAD. See paragraph 43.

g. INSTALL CRANKCASE OIL SUMP ASSEMBLY. See paragraph 46.

h. FILL ENGINE WITH LUBRICATING OIL. See WDLO 6004.

i. TEST CRANKSHAFT. Test crankshaft for tightness by rotating it by hand. The crankshaft should be tight but must not bind. Adjustment for loosening is by using more shims under crankcase rear bearing cover; adjustment for tightening is by removing shims from cover.

Section VIII. CAMSHAFT

115. General

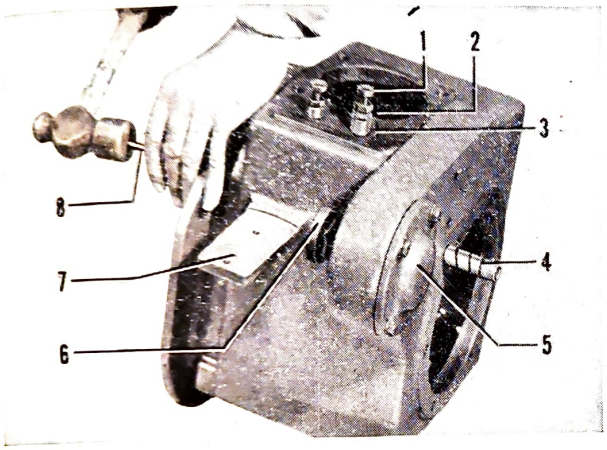
The cams and gear, constructed integrally, idle on a fixed shaft and operate the valve lifters for the intake and exhaust valves. The oil pump connecting rod and plunger has an eye at one end which slips over an eccentric on the cam gear. The fixed shaft is a press fit in the crankcase.

116. Removal

a. Remove Crankcase Rear Bearing Cover. See paragraph 120.

b. Remove Crankshaft. See paragraph 110.

c. Remove Camshaft.



1. *Valve lifter adjusting screw.*
2. *Lock nut.*
3. *Valve lifter.*
4. *Cam and gear shaft.*
5. *Magnetic timing gear cover.*
6. *Magneto coupling.*
7. *Magneto bracket.*
8. *Drift.*

Figure 92. Driving cam and gear shaft out of crankcase.

d. Drive Fixed Shaft Out of Crankcase and Cam and Gear (fig. 92). Remove cam and gear and oil pump connecting rod and plunger from crankcase. Slide oil pump connecting rod and plunger off cam and gear.

117. Inspection and Repair

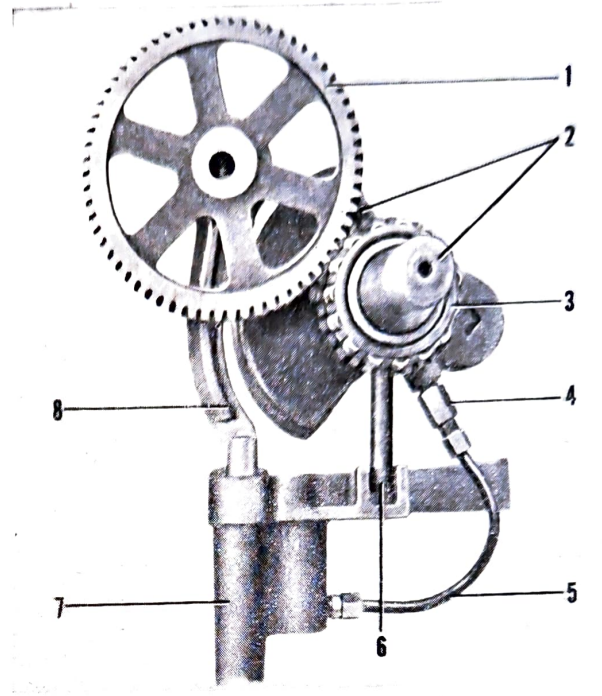
Inspect valve lifter cams, eccentric and shaft for damage; replace cam and gear and fixed shaft if these parts are damaged.

118. Installation

a. Install Oil Pump Connecting Rod and Plunger. **Caution:** The oil pump connecting rod and plunger must be installed in the manner shown in figure 92. Install oil pump connecting rod and plunger.

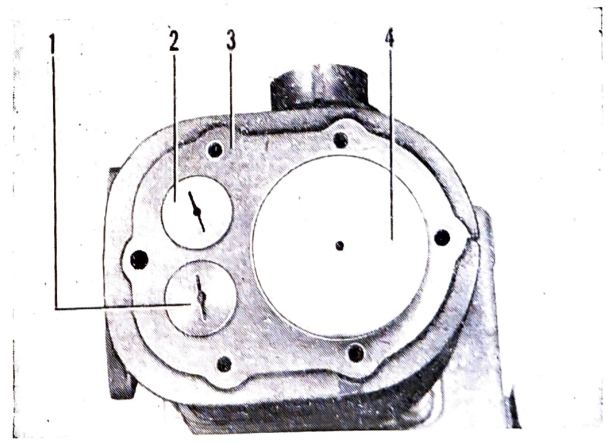
b. Install Crankshaft. See paragraph 112.

c. Install Camshaft. Install cam and gear so that gear is meshed with crankshaft gear when piston is at top dead center and valves are closed. (See fig. 94.) Rock gear slightly; intake valve should start to open as piston starts downward in the cylinder. Rock gear in opposite direction; exhaust valve should start to open as piston starts to move.



1. *Cam timing gear.*
2. *Crankshaft.*
3. *Crankshaft bearing.*
4. *Oil check valve.*
5. *Oil pump to crankshaft collar line.*
6. *Crankshaft collar.*
7. *Oil pump body cylinder.*
8. *Oil pump connecting rod and plunger.*

Figure 93. Correct installation of oil pump connecting rod and plunger.



1. *Exhaust valve closed.*
2. *Intake valve closed.*
3. *Cylinder.*
4. *Piston at top dead center.*

Figure 94. Position of piston and valves when installing camshaft.

d. Drive Fixed Shaft Through the Crankcase and Cam and Gear. See figure 93.

Section IX. CRANKCASE FRONT AND REAR BEARING COVERS

119. General

a. The crankcase rear bearing cover, located at the flywheel end of the crankcase, provides the rear support for the crankshaft, and is the means of adjusting the crankshaft bearings. Shims are used under the cover to obtain the proper tightness of the crankshaft in its bearings. This cover also provides access to the crankcase for the removal of the crankshaft and cam and gear assembly. The rear bearing cover contains the crankshaft rear bearing cup and an oil seal, both of which are pressed in place.

b. The crankcase front bearing cover provides the front support for the crankshaft. An oil seal in the cover prevents lubricant from leaking.

120. Removal (fig. 81)

a. REMOVE REAR BEARING COVER. Remove cap screws and lockwashers which secure crankcase rear bearing cover to crankcase. Remove cover assembly and gasket.

b. REMOVE FRONT BEARING COVER. Remove cap screws and lockwashers which secure crankcase front bearing cover to crankcase. Remove cover assembly and gasket.

121. Inspection and Repair

a. REAR BEARING COVER. (1) Examine the crankshaft rear bearing cup for wear and scoring; if the cup or cone need replacing, replace both parts.

(2) Replace the oil seal if leaking or worn. Replace the oil seal whenever engine is being repaired or reconditioned.

(3) Replace crankcase rear bearing cover gasket.

(4) Test crankshaft for tightness and adjust according to instructions in paragraph *114i.*

b. FRONT BEARING COVER. (1) Replace the oil seal if leaking or worn. Replace the oil seal whenever engine is being repaired or reconditioned.

(2) Replace crankcase front bearing cover gasket.

122. Disassembly of Rear Bearing Cover

Remove crankshaft rear bearing cup and oil seal from crankcase rear bearing cover with puller.

123. Assembly of Rear Bearing Cover

Press crankshaft rear bearing cup and oil seal in crankcase rear bearing cover.

Note. The cup must seat evenly and firmly. The oil seal must be tightly seated and must not be injured during the pressing operation.

124. Installation (fig. 81)

a. INSTALL REAR BEARING COVER. Use new gasket and install crankcase rear bearing cover and gasket on crankcase. Secure with cap screws and lockwashers.

b. INSTALL FRONT BEARING COVER. Use new gasket and install crankcase front bearing cover and gasket on crankcase. Secure with cap screws and lockwashers.

Section X. CYLINDER HEAD

125. Removal

a. REMOVE REAR BODY PANEL. See paragraph 81.

b. REMOVE FAN HOUSING TOP COVER. See paragraph 81.

c. REMOVE CYLINDER HEAD. Remove spark plug using a spark plug wrench; be careful not to injure the spark plug insulator. Remove cylinder head cap screws, cylinder head and gasket.

126. Inspection and Repair

a. Clean cylinder head as instructed in paragraph 43.

b. Replace cylinder head gasket.

127. Installation

Install cylinder head. (See par. 43.)

Section XI. CARBURETORS

128. General

The carburetor, located on the left side of the engine, is mounted to a carburetor pipe which is secured to the intake and exhaust manifold. The carburetor used on this vehicle is either a Tillotson (model YC4A) or a Stromberg (model UR ¾). Both makes of carburetor have an idle mixture adjusting screw, throttle stop screw, and a main adjusting screw. The air intake for the carburetor is provided with a choke valve.

129. Removal

See paragraph 51.

130. Disassembly of Tillotson Carburetor

a. Remove Air Cleaner. See paragraph 49.

b. Separate Throttle Body from Float Chamber (fig. 95). Remove the body retaining screws (12) and lockwashers (13) which attach the throttle body to float chamber. Separate the 2 assemblies and remove the gasket (18).

c. Disassemble Float Chamber (fig. 95). (1) Remove two choke valve retaining screws (32) which secure the choke valve (31) to the choke lever. Remove valve from lever assembly (35).

(2) Remove choke lever return spring (37) and remove choke lever assembly (35) from float chamber. Remove choke lever swivel screw (36) from choke lever assembly.

(3) Remove float chamber drain plug (30), unscrew main adjustment screw (29), and remove main adjustment screw packing nut (28) and packing (27).

(4) Unscrew main adjustment screw gland (26) and remove main adjustment screw gland gasket (25).

(5) Unscrew main nozzle (24) and remove main nozzle gasket (23).

d. Disassemble Throttle Body (fig. 95). (1) Remove float lever pivot pin (17) from float and body. Remove float (21), inlet needle with seat assembly (20) and inlet seat gasket (19).

(2) Remove idle tube (38) from body. Remove two throttle valve retaining screws (11) which secure the throttle valve to throttle shaft. Remove valve (10) from shaft (8).

(3) Remove stop screw (1) and stop screw washer (2). Remove throttle lever (3) from throttle shaft (8).

(4) Unscrew idle speed regulating screw (4) from throttle stop lever (6). Remove idle speed regulating screw spring (5). Unscrew throttle stop lever pin (7) from throttle stop lever (6). Remove throttle stop lever (6) from throttle shaft (8).

(5) Remove throttle shaft (8) from body. Unscrew idle adjustment screw (14) from body. Remove idle adjustment screw spring (15).

131. Inspection and Repair of Tillotson Carburetor

a. Thoroughly clean all parts of the carburetor in solvent, dry cleaning, and blow clean compressed air through all passages. Replace inlet needle with seat (20) assembly if worn; service parts are furnished in sets only. Do not attempt to rework the parts if they are defective. If the throttle shaft (8) has excessive end play or radial clearance, replace the bushing (39) by driving out old bushing and pressing in a new one. Press chamfered end in first.

b. Never use a wire or drill to clean out carburetor passages.

132. Assembly of Tillotson Carburetor

a. Assemble Throttle Body (fig. 95). (1) Install idle adjustment screw spring (15) on idle adjustment screw (14) and turn screw into body. Install throttle shaft (8) into body.

(2) Install throttle stop lever (6) on throttle shaft (8). Screw throttle stop lever pin (7) in throttle stop lever. Install idle speed regulating screw spring and turn idle speed regulating screw (4) into throttle stop lever (6).

(3) Install throttle lever (3) on throttle shaft (8). Install stop screw washer (2) and stop screw (1).

(4) Install throttle valve (10) into slot in throttle shaft (8) and secure valve to shaft with two throttle valve retaining screws (11). Install idle tube in body.

(5) Install inlet seat gasket (19), inlet needle with seat assembly (20) and float (21) in body. Install float lever pivot pin (17) in float and body.

(6) Turn throttle body assembly upside down. See that float lever is resting on the inlet needle. Bend each float lever arm if necessary, to give a distance of $1^{5}/_{64}$ inches from face of body gasket to the top of the raised seam encircling the float.

b. Assemble Float Chamber (fig. 95). (1) Install main nozzle gasket (23) on main nozzle (24) and screw nozzle into float chamber.

(2) Install main adjustment screw gland gasket (25) on main adjustment screw gland (26) and screw gland into float chamber.

(3) Install main adjustment screw packing (27) and turn main adjustment screw packing nut (28) into float chamber. Turn main adjustment screw (29) into float chamber. Install float chamber drain plug (30).

(4) Install choke lever swivel screw (36) in choke lever assembly. Install choke lever assembly (35) in float chamber and install choke lever return spring (37).

(5) Install choke-valve (31) into slot in choke lever assembly and secure valve to lever with two choke-valve retaining screws (32).

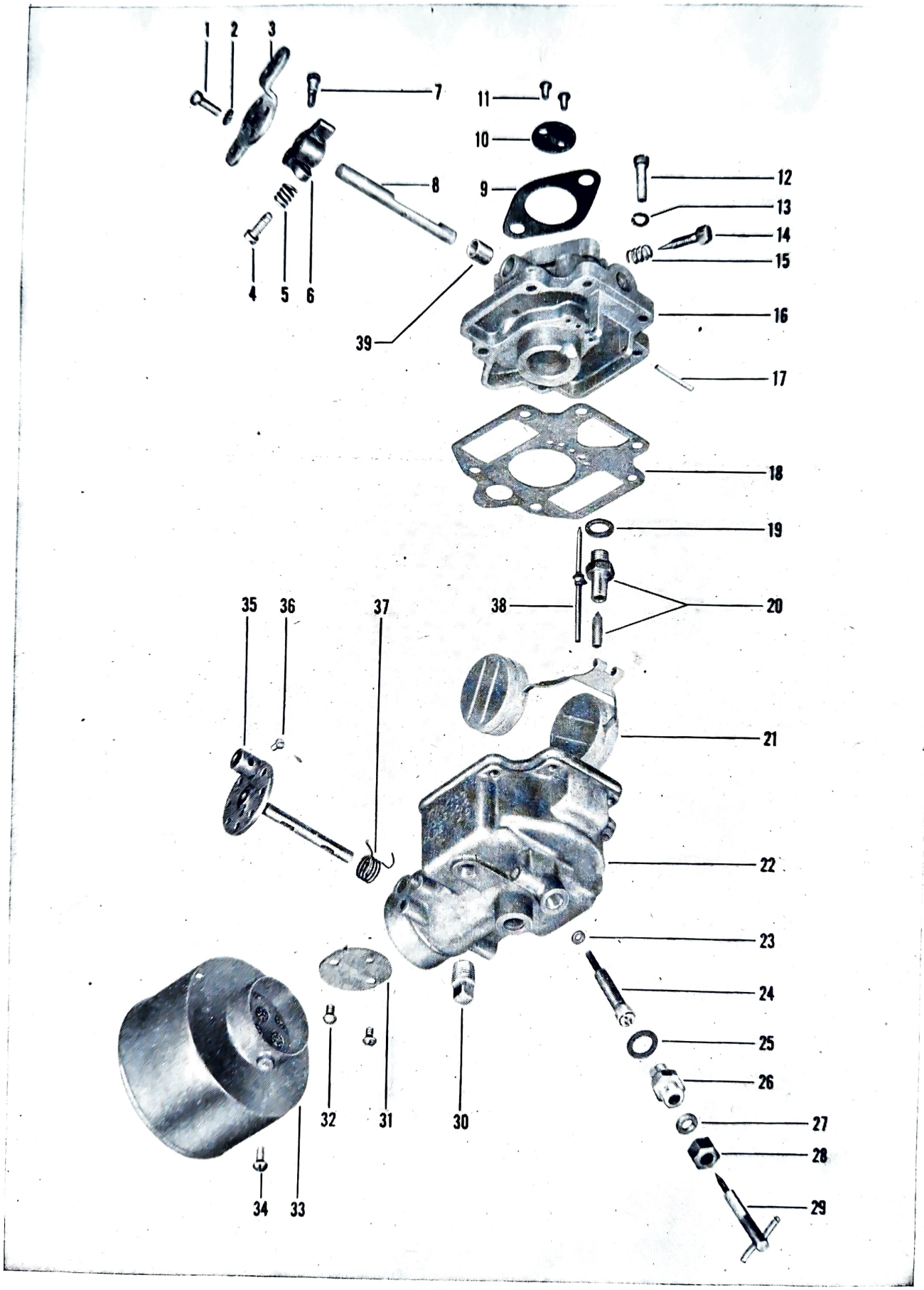


Figure 95. Tillotson carburetor assembly (YC-4A).

Legends for figure 95.

1. *Stop screw.*
2. *Stop screw washer.*
3. *Throttle lever.*
4. *Idle speed regulating screw.*
5. *Idle speed regulating screw spring.*
6. *Throttle stop lever.*
7. *Throttle stop lever screw.*
8. *Throttle shaft.*
9. *Flange gasket.*
10. *Throttle valve.*
11. *Throttle valve retaining screw.*
12. *Body retaining screw.*
13. *Lockwasher.*
14. *Idle adjustment screw.*
15. *Idle adjustment screw spring.*
16. *Throttle body.*
17. *Float lever pivot pin.*
18. *Body gasket.*
19. *Inlet seat gasket.*
20. *Inlet needle with seat assembly.*
21. *Float.*
22. *Float chamber.*
23. *Main nozzle gasket.*
24. *Main nozzle.*
25. *Main adjustment screw gland gasket.*
26. *Main adjustment screw gland.*
27. *Main adjustment screw packing.*
28. *Main adjustment screw packing nut.*
29. *Main adjustment screw.*
30. *Float chamber drain plug.*
31. *Choke valve.*
32. *Choke valve retaining screw.*
33. *Air cleaner.*
34. *Air cleaner set screw.*
35. *Choke lever and shaft assembly.*
36. *Choke lever swivel screw.*
37. *Choke lever return spring.*
38. *Idle tube.*
39. *Throttle shaft bushing.*

c. ASSEMBLE FLOAT CHAMBER AND THROTTLE BODY. Install gasket (18) and place the two halves together. Secure the two halves with retaining screws (12) and lockwashers (13).

d. INSTALL AIR CLEANER. See paragraph 49.

133. Disassembly of Stromberg Carburetor

a. REMOVE AIR CLEANER. See paragraph 49.

b. SEPARATE THROTTLE VALVE BODY FROM MAIN BODY (fig. 96). Remove throttle valve body attaching screws (5) and washers (6) which secure the throttle valve body (9) to the main body (20). Separate the bodies and remove the main body gasket (11).

c. DISASSEMBLE THROTTLE VALVE BODY (fig. 96). (1) Unscrew idle needle valve (8) from body and remove idle needle valve spring (7).

(2) Unscrew two throttle valve screws (3) which secure throttle valve to throttle shaft (1). Remove throttle valve (2) from throttle shaft. Loosen clamp screw on throttle lever assembly (4) and remove lever assembly (4) from throttle shaft (1). Remove throttle shaft (1) from body.

(3) Remove float fulcrum pin (13) from float hanger (14) and float (17). Remove float (17), float needle valve and seat (16), and float needle valve seat gasket (15).

(4) Remove float hanger (14) from float hanger pin (10). Remove float hanger gasket (12).

d. DISASSEMBLE MAIN BODY (fig. 96). (1) Remove venturi (36), unscrew high speed bleeder (35), idle tube (18), main metering jet (19), and vent tube (34) from body.

(2) Unscrew high speed needle valve (26), high speed jet packing nut (25), and high speed jet nipple (24) from body. Remove high speed jet gasket (23). Unscrew high speed jet (22) from body and remove main discharge jet gasket (27).

(3) Remove choke-lever shaft washer (28) from choke lever shaft (32). Remove two choke valve screws (30) which secure choke valve (29) on choke lever shaft (32). Remove choke valve (29) from choke lever shaft (32).

(4) Remove choke lever spring (33). Remove choke lever and shaft (32) from body.

134. Inspection and Repair of Stromberg Carburetor

Carburetor data	
Venturi	—¾ inch.
Main discharge jet	—No. 52.
High speed bleeder	—No. 60.
Main metering jet	—.048 inch.
Idle discharge nozzle	—No. 72.
Idle tube	—No. 72.

a. INSPECTION AND REPAIR. Thoroughly clean all parts of the carburetor in solvent, dry cleaning, and blow clean compressed air through all passages. Replace the float needle valve and seat if worn; service parts are furnished in sets only. Do not attempt to repair the parts if they are defective.

b. FLOAT LEVEL. The gasoline level in the float chamber is properly set at the factory and should not be adjusted unless level has been changed. The fuel level is set at 9/16 inch below the top of the main body. If necessary to reset level, bend float lever arm at the corner where it touches the float

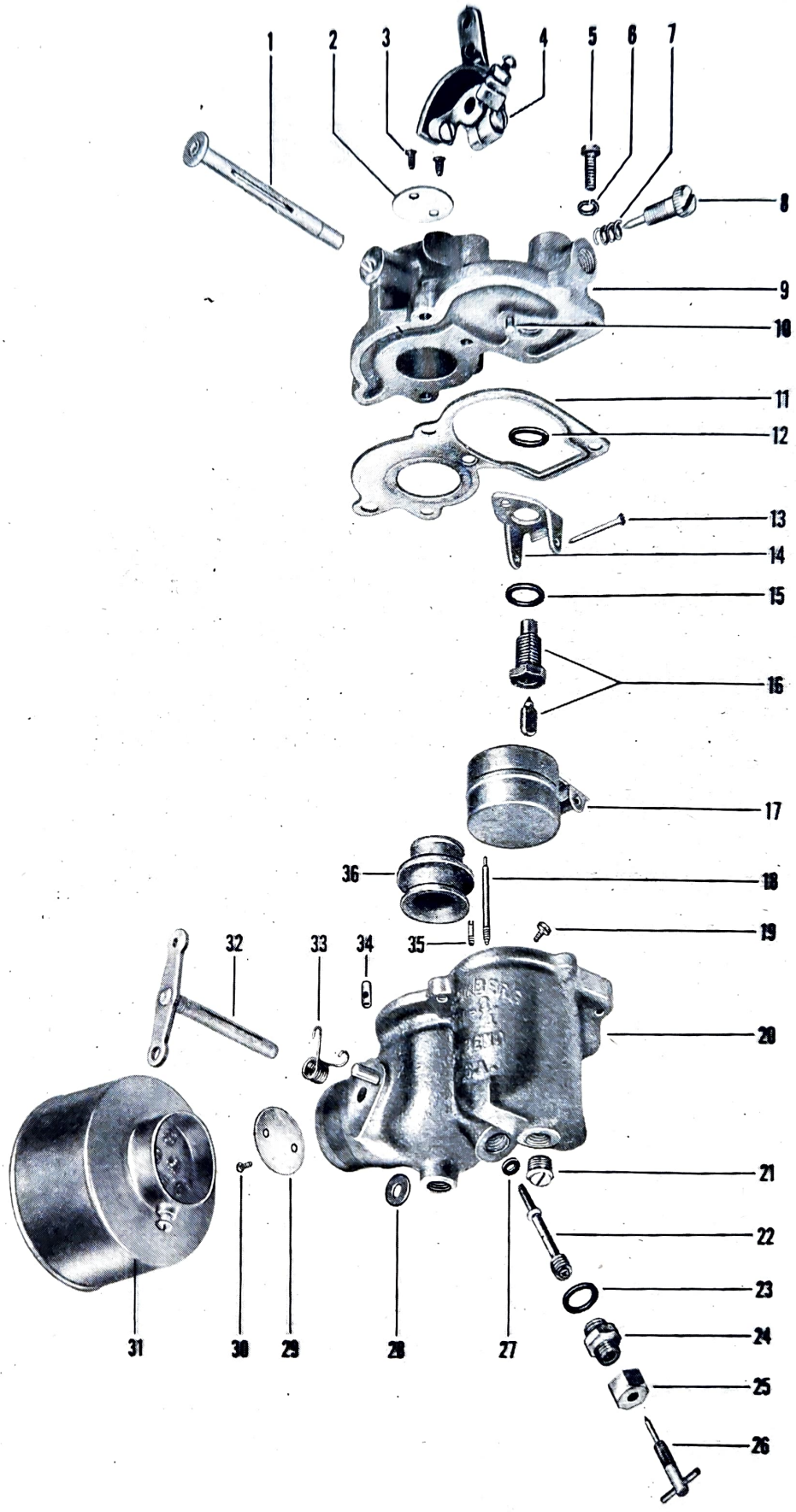


Figure 96. Stromberg carburetor assembly (UR–¾)

Legends for figure 96.

1. *Throttle shaft.*
2. *Throttle valve.*
3. *Throttle valve screw.*
4. *Throttle lever assembly.*
5. *Throttle valve body attaching screw.*
6. *Lockwasher.*
7. *Idle needle valve spring.*
8. *Idle needle valve.*
9. *Throttle valve body.*
10. *Float hanger pin.*
11. *Main body gasket.*
12. *Float hanger gasket.*
13. *Float fulcrum pin.*
14. *Float hanger.*
15. *Float needle valve seat gasket.*
16. *Float needle valve and seat.*
17. *Float with lever assembly.*
18. *Idle tube.*
19. *Main metering jet.*
20. *Main body.*
21. *Body drain plug.*
22. *High-speed jet.*
23. *High-speed jet gasket.*
24. *High-speed jet nipple.*
25. *High-speed jet packing nut.*
26. *High-speed needle valve.*
27. *Main discharge jet gasket.*
28. *Choke lever shaft washer.*
29. *Choke valve.*
30. *Choke valve screw.*
31. *Air cleaner.*
32. *Choke lever and shaft.*
33. *Choke lever spring.*
34. *Vent tube.*
35. *High speed bleeder.*
36. *Venturi.*

L

and see that the distance from the top of the float to the machined surface of the throttle valve body is $1\frac{1}{32}$ inch. If the level is low, bend the lever up $\frac{1}{16}$ inch; if high, bend the lever down $\frac{1}{16}$ inch.

135. Assembly of Stromberg Carburetor

a. Assemble Main Body (fig. 96). (1) Install choke lever and shaft (32) in body. Install choke lever spring (33).

(2) Install choke valve (29) in slot in choke lever shaft and secure valve to shaft with two choke valve screws (30). Install choke lever shaft washer (28) on choke lever shaft and peen over end of shaft to hold washer in place.

(3) Install main discharge jet gasket (27), high speed jet (22), high speed jet gasket (23), high speed jet nipple (24), high speed jet packing nut (25), and high speed needle valve (26).

(4) Install vent tube (34), main metering jet (19), idle tube (18), high speed bleeder (35), and venturi (36).

b. Assemble Throttle Valve Body (fig. 96). (1) Install float hanger gasket (12) and float hanger (14) on float hanger pin (10).

(2) Install float needle valve seat gasket (15), float needle valve and seat (16) and float (17). Secure float by installing fulcrum pin (13) through float hanger (14) and float (17).

(3) Adjust float level. (See par. 134*b*.)

(4) Install throttle shaft (1) in body. Install lever assembly (4) on throttle shaft and secure by tightening clamp screw. Install throttle valve (2) through slot in throttle shaft and secure with two throttle valve screws (3).

(5) Install idle needle valve spring (7) and idle needle valve (8).

c. Assemble Throttle Valve Body to Main Body (fig. 96). Install main body gasket (11), place throttle valve body (9) on main body (20), and secure with throttle valve body attaching screws (5) and washers (6).

d. Install Air Cleaner. See paragraph 49.

136. Installation

See paragraph 51.

Section XII. EISEMANN MAGNETO

137. General

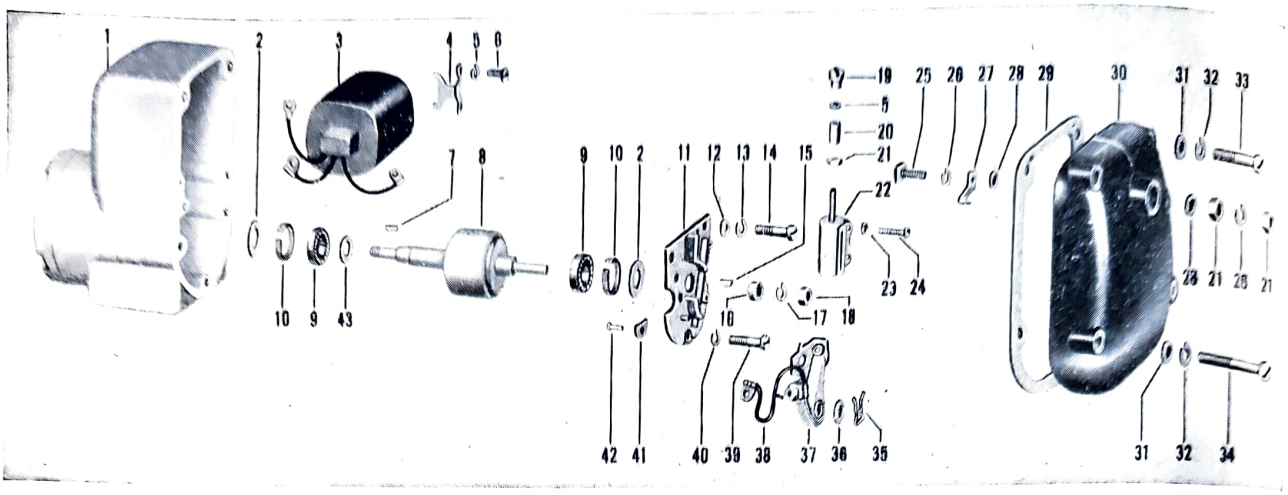
a. The Eisemann magneto (model AM-1) consists of a housing, winding assembly, rotor and bearings, housing end plate, condenser, breaker point mechanism, distributor cover, and impulse starter mechanism.

b. The breaker point mechanism is of the lever type which permits adjustment by loosening one screw. The breaker points are accessible by removing a cover located on the front end of the magneto.

c. The impulse starter mechanism is not adjustable but can be reached for cleaning by removing a cover located at the rear end of the magneto.

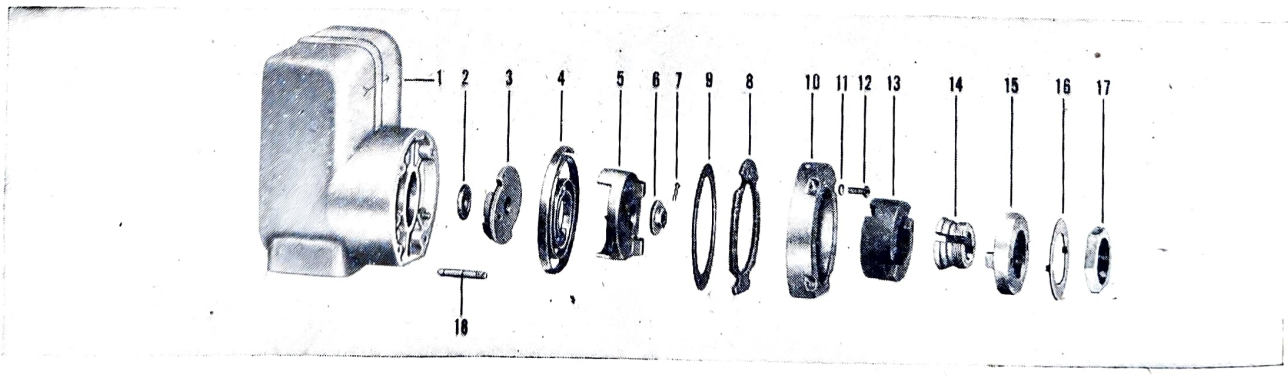
138. Removal

See paragraph 63.



1. *Housing.*
2. *Insulating washer.*
3. *Winding assembly.*
4. *Winding clamp.*
5. *Lockwasher.*
6. *Attaching screw.*
7. *Woodruff key.*
8. *Rotor.*
9. *Rotor shaft ball bearing.*
10. *Insulating strip.*
11. *Housing end plate.*
12. *Plain washer.*
13. *Lockwasher.*
14. *Adjusting screw.*
15. *Woodruff key.*
16. *Breaker cam.*
17. *Lockwasher.*
18. *Breaker cam nut.*
19. *Slotted nut.*
20. *Condenser post spacing bushing.*
21. *Condenser post hexagon nut.*
22. *Condenser with bracket assembly.*
23. *Lockwasher.*
24. *Attaching screw.*
25. *Ground terminal binding post.*
26. *Lockwasher.*
27. *Ground terminal switch contact clip.*
28. *Plain washer.*
29. *Breaker cover gasket.*
30. *Breaker cover.*
31. *Plain washer.*
32. *Lockwasher.*
33. *Breaker cover upper holding screw.*
34. *Breaker cover lower holding screw.*
35. *Spring clip.*
36. *Spacing washer.*
37. *Breaker arm assembly and adjustable point plate.*
38. *Breaker to condenser lead.*
39. *Housing end plate attaching screw.*
40. *Lockwasher.*
41. *Lubricating felt.*
42. *Lubricating felt attaching rivet.*
43. *Bearing spacing washer.*

Figure 97. Eisemann magneto housing, winding, rotor, housing end plate, and breaker cover.



1. *Housing.*
2. *Dust seal.*
3. *Flange with pawl assembly.*
4. *Impulse starter driving spring.*
5. *Impulse starter coupling.*
6. *Rotor shaft nut.*
7. *Cotter pin.*
8. *Impulse starter dust cover packing.*
9. *Impulse starter dust cover retaining ring.*
10. *Impulse starter dust cover.*
11. *Lockwasher.*
12. *Impulse starter dust cover mounting screw.*
13. *Alignment joint.*
14. *Drive coupling compression collar.*
15. *Drive coupling adjustable coupling.*
16. *Drive coupling lockwasher.*
17. *Drive coupling lock nut.*
18. *Impulse starter catch pin.*

Figure 98. Eisemann magneto housing, impulse starter, and dust cover.

139. Disassembly

a. Drive Coupling (fig. 98). Bend tangs of lock washer (16) off lock nut (17). Loosen lock nut and unscrew compression collar (14). Remove alignment joint (13), drive coupling adjustable coupling (15), lock washer (16), and lock nut (17).

b. Dust Cover (fig. 98). Remove impulse starter dust cover mounting screws (12) and lockwashers (11). Remove impulse starter dust cover (10), retaining ring (9), and packing (8).

c. Impulse Starter (fig. 98). Remove cotter pin (7) from rotor shaft nut (6). Hold impulse starter cup and remove castellated nut (6) from drive shaft. Using puller, loosen impulse starter (5) on drive shaft, but do not remove.

d. Breaker Cover (fig. 97). Remove two upper screws (33) and two lower screws (34). Remove cover (30) from housing (1).

e. Breaker Cam (fig. 97). Remove breaker cam nut (18) and lockwashers (17) from breaker end of shaft. Remove the breaker cam (16) and woodruff key (15) from shaft. Then remove the impulse starter (5, fig. 98) from shaft.

f. Condenser (fig. 97). Remove the slotted nut (19), lockwasher (5), spacing bushing (20) and hexagon nut (21) from condenser post. Remove two screws (24) and lockwashers (23) from condenser bracket (22). Lift breaker (38) and winding lead from post and remove the condenser (22).

g. Contact Breaker (fig. 97). Remove adjusting screw (14), lockwasher (13), and plain washer (12) from end plate (11). Remove spring clip (35) and spacing washer (36) from breaker (37) and lift breaker (37) from pivot in end plate (11).

h. Housing End Plate (fig. 97). Remove the three screws and remove the end plate (11) from the housing (1). The outer races will remain in the end plate and housing.

i. Winding (fig. 97). Remove the four screws (6) and lockwashers (5). Lift clamps (4) from winding core. The winding may be a tight fit due to the taper fit of the winding core to the housing, do not use a screw driver or any tool to loosen it. To remove winding assmbly (3), tap the upper edge of the housing on a block of wood; hold winding to prevent it from dropping.

j. Rotor and Shaft (fig. 97). Remove rotor and shaft (8) from the magneto housing.

140. Inspection and Repair

a. Cleaning. When the magneto is disassembled, wash all parts except the winding and condenser in solvent, dry cleaning, and carefully dry with a clean lint-free cloth.

b. Inspection and Repair. (1) *Condenser.* Test the condenser on a condenser tester. A good condenser would meet the following specifications:

Capacity—18–22 microfarads.

Service resistance—not over 0.4 ohm.

Leakage—50,000 ohms minimum.

Replace, if defective.

(2) *Breaker.* Do not dismantle breaker. If contacts are badly burned replace complete breaker; otherwise resurface with a very thin carborundum stone.

(3) *Ball bearings.* Inspect the inner ball races and retainers on rotor shaft and outer ball races in housing and end plate for pitting or roughness. If defective, replace complete ball bearings.

(4) *Removing outer ball races.* Remove races with an approved bearing puller.

(5) *Replacing outer ball races.* Ball bearings are insulated from their recesses. When races are removed, the insulation strips and washers are damaged and should be replaced with strips and washers of the proper thickness to insure a tight fit. (These parts are furnished in varying thicknesses.) Place new washer in recess, form insulation strip into a circle and place in recess in housing and end plate. Place housing or end plate on support block, position outer race and press race into seat. If insulation strips crimp, repeat the operation. When properly seated, the insulation strip will protrude; cut off excess with a sharp knife.

(6) *Removing inner ball races from rotor shaft.* Remove races, balls, and retainer with an approved bearing puller.

(7) *Replacing inner ball races on shaft.* Press races, balls, and retainers on rotor shaft.

(8) *Dust seal.* Replace dust seal if worn.

141. Assembly

a. (fig. 97). Before assembling magneto, be sure the housing and rotor shaft are free from dirt or metal chips, which would score the laminations or cause binding. Install winding (3) in housing (1) with the insulated and bare leads on the right hand side. The winding should fit parallel with the top of the housing. Secure clamps (4) with lockwashers (5) and screws (6). The terminal of the bare lead from winding should be placed under the upper hole on right hand clamp and held by the same clamp screws. Assemble cages with balls and races on rotor shaft. Pack balls with proper

grease and install in housing. Position housing end plate (11) and tighten the three screws; turn shaft while tightening screws.

b. Test rotor for end play or binding. If either is present, remove end plate and rotor shaft. Remove inner ball race on breaker end of shaft and add or remove spacing washers until the rotor shaft turns freely without end play. Tighten end plate screws securely.

c. (fig. 97). Install contact breaker (37), on pivot pin in end plate (11). Place spacing washer on pivot pin and lock with spring clip (35). Install adjusting screw with lockwasher and plain washer (12, 13, 14) through breaker plate into end plate. Leave screw slightly loose.

d. (fig. 97). Mount condenser (22) on end plate securely with screws (24) and lockwashers (23). Place spacing bushing (20) and hex nut (21) on condenser post. Attach the insulated leads from winding and breaker (38) to post, and secure with lockwasher (5) and slotted nut (19).

e. (fig. 97). Install key (15) and breaker cam (16) on shaft with the slot on end of the cam facing outward. Assemble lockwasher (17) and breaker cam nut (18) on shaft. To tighten nut properly, place Woodruff key in drive end of shaft and mount impulse starter (5, fig. 98) loosely, holding the impulse starter when tightening nut. Turn rotor shaft until the fiber bumper on breaker rests on the highest point of cam. Inspect distance between contacts which should be 0.015 inch. Move stationary point on breaker toward breaker arm point to decrease distance or away from it to increase distance. When correct adjustment is obtained, tighten adjusting screw (14) securely. Install breaker cover on housing.

f. (fig. 98). Secure impulse starter (5) on shaft with castellated nut (6). Align holes in nut and shaft and install cotter pin (7). Assemble complete dust cover to housing using screws and lockwashers (11 and 12).

g. (fig. 98). Install lock nut (17), lockwasher (16), and alignment joint (13), and adjustable coupling (15) on magneto drive shaft. Screw lock nut (17) on compression collar (14). Bend tangs of lockwasher (16) over lock nut (17).

142. Installation

See paragraph 63.

Section XIII. WICO MAGNETO

143. General

See paragraph 63.

144. Removal

See paragraph 63.

145. Disassembly of Wico Magneto

a. Condenser (fig. 100). Remove breaker housing cover. Disconnect the ground and coil leads by removing the breaker arm screw (17) and washers (15 and 16). Remove the two condenser screws, (10) and lockwashers (9); remove the condenser by sliding it slightly away from the breaker arm pivot and pulling it upward.

b. Main Housing Cover. To remove main housing cover, (22, fig. 99) with the breaker assembly intact, remove the breaker housing cover (24), loosen the breaker arm spring screw (18, fig. 100) and remove the coil and ground lead terminal. Loosen each of the four main housing screws (26, fig. 99) in corners of the main housing cover until they are free. It is not necessary to completely remove the screws from the cover. If the cover sticks, loosen by tapping lightly with the palm of the hand. Remove gasket (23).

c. Coil Testing. It is not necessary to remove the coil from the magneto for testing. Using an approved coil tester, connect the ground lead of the breaker lead of the tester to the breaker arm spring terminal screw of the magneto; connect the spark lead of the tester to the high tension terminal on the coil; turn the cam until the breaker points are open. The coil must be replaced if it requires more than 1.6 amperes to give a steady spark on a 5-mm gap.

d. Removal of Coil and Coil Core Unit (fig. 99). With the magneto housing cover (22) removed, remove the two fillister head screws (17) and lockwashers (16) securing the coil core clamps (15). The ground lead of the coil is located under the coil clamp screw lockwasher. Turn the rotor until the magnetism no longer grips the coil core to the main housing. Pull the coil (19) and coil core (29) free.

e. Dust Cover (fig. 101). To remove the dust

cover (30), loosen the small screw (3) which holds it in place. Remove dust cover (30), gasket (29), and dust cover ring (28), from the magneto. Replace dust cover gasket if worn.

f. Removal of Coil from Core (fig. 99). The coil (19) is secured to the coil core (29) by two pole shoes (14 and 31). Press against the coil core with considerable force to remove it from the coil. Support the coil to prevent the primary of the coil from being pushed out of the secondary.

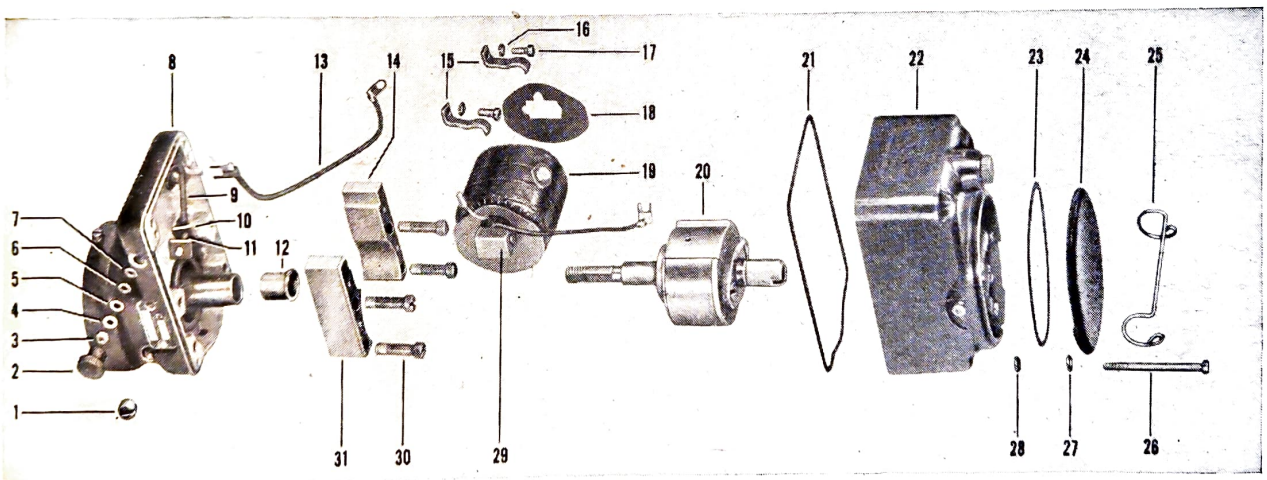
g. Impulse Coupling (fig. 101). The impulse lock nut (25) has a right-hand thread; to unscrew it, prevent the rotor shaft from turning while the nut is being loosened.

h. Impulse Starter Coupling and Drive Spring (fig. 101). (1) To remove the impulse starter coupling (24) with the drive spring (23), turn the starter coupling (24) in the direction of magneto rotation until the trip arm (16) latches against the impulse stop (12). Continue to turn the coupling until its projection has cleared the projection on the driven flange (15). When friction of these parts against each other has been removed, the coupling can be pulled out far enough to allow the drive spring to unwind. Grip the coupling firmly to prevent injury to the hand. Remove the coupling, with the spring still in it, from the shaft.

(2) To remove the drive spring (23) from the coupling, work the spring out.

i. Trip Arm (fig. 101). To remove trip arm (16), clamp the driven flange (15) in a vise and push the point of a knife between the snap ring and the trip arm pivot, near the opening of the snap ring (17). This will spring the snap ring a little; then insert a knife between the snap ring and pivot as far from the opening as possible and remove the ring. Remove trip arm (16). Replace snap ring if damaged during removal.

j. Impulse Stop Assembly (fig. 101). The impulse stop assembly (12), used on the model G magneto, holds the driven flange and rotor stationary while the impulse is winding; it contains an oil seal which prevents the lubricating oil from entering the magneto. If necessary to remove the impulse stop group from the housing, note location of the marks on the impulse stop assembly with reference to the graduations on the side of the housing; reinstall in original position to prevent change in lag angle.



1. *Oil plug.*
2. *Lead wire clamp nut.*
3. *Ground stud nut.*
4. *Ground stud washer.*
5. *Ground stud insulating washer.*
6. *Ground stud insulating bushing.*
7. *Ground stud insulating bushing.*
8. *Main housing assembly.*
9. *Lead to ground stud.*
10. *Ground stud lock.*
11. *Ground stud.*
12. *Rotor bushing.*
13. *Ground stud lead.*
14. *Pole shoe.*
15. *Coil core clamp.*
16. *Lockwasher.*
17. *Screw.*
18. *Coil gasket.*
19. *Coil assembly.*
20. *Rotor.*
21. *Housing cover gasket.*
22. *Housing cover.*
23. *Breaker housing cover gasket.*
24. *Breaker housing cover.*
25. *Cover bail.*
26. *Main housing screw.*
27. *Washer.*
28. *Washer.*
29. *Coil core assembly.*
30. *Pole shoe attaching screw.*
31. *Pole shoe.*

Figure 99. Wico magneto breaker housing, rotor, coil, main housing (Wico C–1).

k. OILING SYSTEM PARTS (fig. 101). After the impulse stop assembly and all other impulse coupling parts have been removed, the impulse stop spacer (10) and oiling disk (9) may be removed from the rotor shaft. Then remove the main oil pad (8), the oil pad spring plate (7), and the oil scraper assembly (6) from the main housing.

l. MAIN HOUSING (fig. 99). **Caution:** Under no condition should the four screws securing the pole shoes (14 and 31) on the main housing be removed. These shoes are finished to close tolerances to maintain the proper air gap between the cores and the rotor.

146. Inspection and Repair

a. CLEANING. Wash all parts except the winding and condenser in solvent, dry cleaning, and dry with a clean lint-free cloth.

b. CONDENSER. Test condenser on a condenser tester. The condenser must meet the following specifications:

Capacity—18–22 microfarads.

Series resistance—not over 0.4 ohm.

Leakage—50,000 ohms minimum.

If condenser does not meet these specifications, replace.

c. BREAKER. If contacts are badly burned, replace; otherwise resurface with a very thin carborundum stone.

d. ROTOR BUSHING. Try fit of rotor bushing on rotor shaft; if there is more than .005 clearance between bushing and shaft, replace bushing.

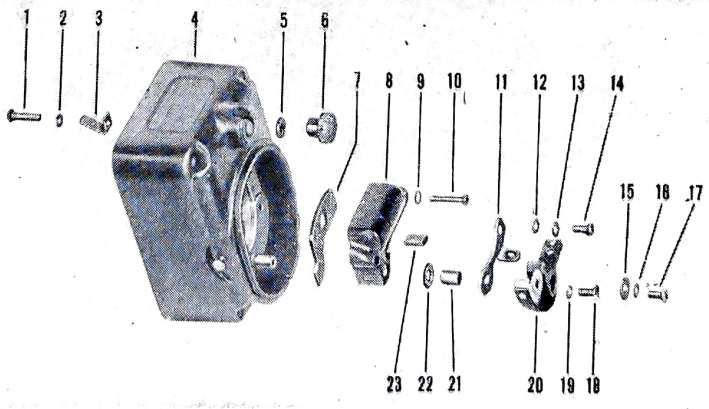
e. IMPULSE DUST COVER. Replace impulse dust cover gasket and dust cover, if worn.

147. Assembly

a. MAIN HOUSING. When replacing the main housing, use replacement housing group. All model C replacement housings are furnished with name plates, oil catchers, oil plugs, cover gasket, and ground studs on both right- and left-hand side, complete with ground and lead wires.

b. OILING SYSTEM PARTS (fig. 101). Install oiling disk (9) and the impulse stop spacer (10). Saturate oil pad (8) with oil (see War Department Lubrication Order) and install oil pad. Install oil pad spring plate (7) and be certain that there is sufficient tension in the spring to hold the main oil pad securely against the oiling disk, otherwise replace plate. Install oil scraper assembly in the hole provided, making certain that the scraper itself is in groove and does not get caught and lay over the oil hole, causing the oil circulation to be stopped.

c. IMPULSE STOP ASSEMBLY (fig. 101). Install impulse stop assembly so that marks are in original



1. *Terminal screw.*
2. *Lockwasher.*
3. *Coil contact.*
4. *Housing cover.*
5. *Terminal screw nut washer.*
6. *Terminal screw nut.*
7. *Condenser case gasket.*
8. *Condenser assembly.*
9. *Washer.*
10. *Condenser screw.*
11. *Fixed contact point.*
12. *Washer.*
13. *Washer.*
14. *Fixed contact screw.*
15. *Washer.*
16. *Washer.*
17. *Breaker arm screw.*
18. *Breaker arm spring screw.*
19. *Washer.*
20. *Breaker arm and spring.*
21. *Breaker arm spacer.*
22. *Breaker arm spacing washer.*
23. *Cam oil pad.*

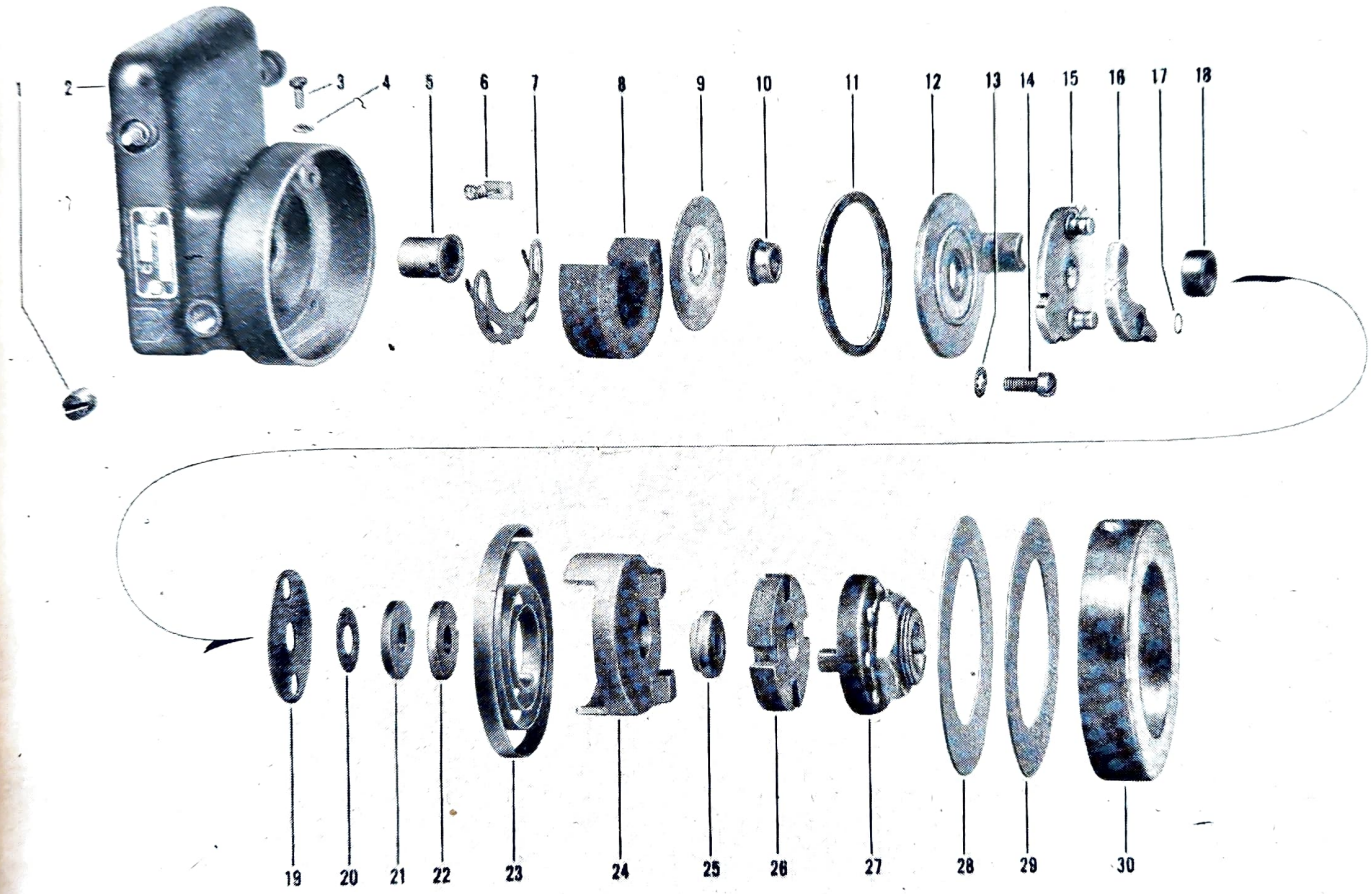
Figure 100. Wico magneto breaker housing.

position with reference to the graduations on the side of the housing. If necessary to replace the oil seal, replace the impulse stop assembly as a unit. Install new impulse stop gasket (11).

d. Trip Arm (fig. 101). Install trip arm (16) and secure with new snap ring, using a socket wrench slightly larger than the pivot. Put the ring on the pivot and press down on the ring with the open end of the socket wrench.

e. Impulse Starter Coupling and Drive Spring (fig. 101). (1) Install drive spring (23) over the coupling (24) so that the outer eye of the spring fits as far as possible over the slot provided inside the wall of the coupling. The spring should be installed so that the coils spiral in toward the inner eye in a clockwise direction.

(2) Insert a larger screw driver in the centerhole of the starter coupling spacing washer (21) which contains the slot for the inner eye, so that it will bind and the spacer can be turned with the



1. *Oil plug.*
2. *Main housing.*
3. *Dust cover screw.*
4. *Lockwasher.*
5. *Rotor bushing.*
6. *Oil scraper assembly.*
7. *Main oil pad spring plate.*
8. *Main oil pad.*
9. *Oiling disk.*
10. *Impulse stop spacer.*
11. *Impulse stop gasket.*
12. *Impulse stop assembly.*
13. *Impulse stop screw washer.*
14. *Impulse stop screw.*
15. *Driven flange assembly.*
16. *Trip arm.*
17. *Trip arm snap ring.*
18. *Driven flange spacer.*
19. *Driven spring retainer.*
20. *Driven flange spacing washer.*
21. *Starter coupling spacing washer.*
22. *Starter coupling spacing washer.*
23. *Drive spring.*
24. *Impulse starter coupling.*
25. *Impulse lock nut.*
26. *Impulse coupling disk.*
27. *Coupling assembly.*
28. *Dust cover ring.*
29. *Dust cover gasket.*
30. *Dust cover.*

Figure 101. Wico magneto main housing, impulse drive parts and drive coupling.

screw driver acting as a handle. Insert the inner eye of the spring in the spacing washer slot and wind the spring around the spacing washer until the spiral closes sufficiently to allow the spring to slide inside the starter coupling. This method of winding eliminates any possiblity of distorting the spring surface. The spring may be more easily inserted if the lugs of the starter coupling are securely held in a vise.

(3) Be sure that all parts are clean and that there is grease between the coils of the drive spring. Install the brass and steel spacing washers into the starter coupling with the inner eye, the springs, and notch provided in the washer. Install the starter coupling with spring and the spacing washers on the shaft. Press the parts together, holding the starter coupling out far enough so that its projection clears the flange; then turn the coupling a full turn as follows:

Make a half turn and allow the projections to lock against the driven flange; then with a fresh hold on the coupling make the other half turn. When the spring is wound, press the coupling firmly into place, install lock nut and apply a small amount of grease to the bearing surface of the impulse lock nut (25). Install dust cover.

f. Impulse Coupling (fig. 101). (1) Install impulse lock nut (25), and rotate the starter coupling (24) until the trip arm (16) is against the impulse stop (12). This will arrest further movement of the rotor so that the lock nut may be securely tightened.

(2) Install dust cover (30), gasket (29), ring (28), coupling assembly (27), and disk (26).

g. Install Coil in Core (fig. 99). Install coil (19) on coil core (29), being sure that the finished side of the core is down and the high tension button on the coil is up. Then press in the two pole shoes (14 and 31) on the finished side of the core, one on each side, until they are flush with the primary coil winding. Install the coil gaskets (18), one on each side, and thread the primary lead through the slot provided in the coil shield.

h. Dust Cover (fig. 101). Install dust cover ring (28), new gasket (29), and dust cover (30). Tighten screw (3) which holds dust cover in place.

i. Install Coil and Coil Core Unit (fig. 99). Install coil core (29) and coil (19), so that ground surface of core is against laminated cores of housing. Install coil ground lead under core clamp screw lockwasher and not under the coil core clamp (15). Install two coil core clamps (15) and secure with two fillister head screws and lockwashers. Install magneto housing cover (22).

Note. When the coil is in place, the coil terminal should be up and toward the breaker point. The surface of this contact must be clean.

j. Main Housing Cover (fig. 99). Cement gasket (23) to main housing. Install main housing cover and secure to main housing with four main housing screws (26). Install coil and ground lead terminals and secure with breaker arm spring screw (18, fig. 100).

k. Condenser (fig. 100). Install condenser by sliding it slightly toward the breaker arm pivot and pulling it downward. Install two condenser screw washers (9) and screws (10). Connect the ground and coil leads under the breaker arm screw (17) and install screw and washers (15 and 16). Install condenser case gasket (7). Install breaker housing cover.

148. Installation

See paragraph 63.

Section XIV. CLUTCHES

149. General

See paragraph 64.

150. Adjustments

a. Inspect Forward and Reverse Motion Clutches. Start the engine and allow the brake pedal to raise as far as possible (brake applied position). Place motion control lever in forward position and rapidly pull back to reverse position. It should be possible to move the motion control lever rapidly from forward to reverse (for reverse to forward) and in doing so to stop the engine. If the engine is not stopped, the clutches must be adjusted. (See step *c* below.)

b. Inspect Lift Raising and Lowering Clutches. Start the engine and operate the lift both up and down. The action must be smooth, without drag.

c. Adjust Lift or Motion Clutches.

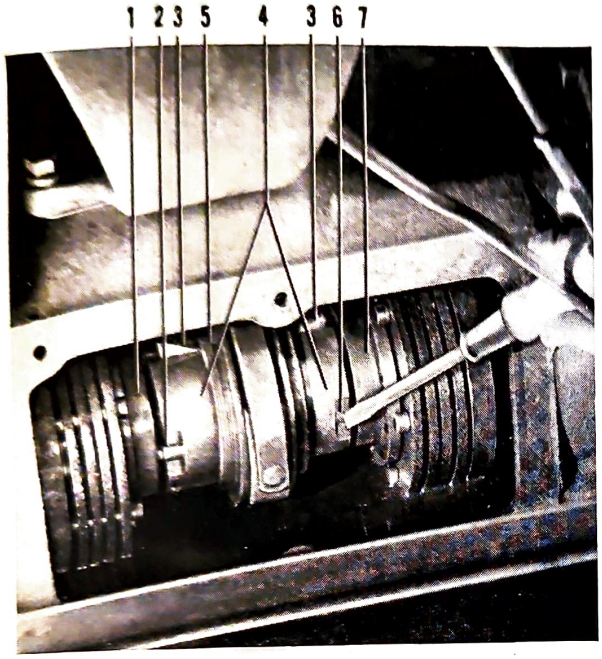
Note. The clutches on the right side of the clutch and transmission case operate the vehicle.

The rear clutch provides vehicle forward motion; the front clutch provides reverse motion. The clutches on the left side of the clutch case operate the lift. The rear

clutch controls the lowering of the carriage; the front clutch controls raising the carriage. All clutches are adjusted in the same manner.

(1) Remove the lower panel on both sides of vehicle body. Remove the cap screws securing the clutch inspection plates on the right and left sides of the clutch case. Remove the inspection plates.

(2) Pull ignition switch knob to the out position to prevent possibility of the engine being started.



1. *Clutch adjusting nut.*
2. *Clutch adjusting lock pin.*
3. *Clutch dog.*
4. *Clutch body.*
5. *Clutch shifter collar.*
6. *Clutch adjusting lock pin.*
7. *Clutch adjusting nut.*

Figure 102. Prying clutch adjusting lock pin back for reverse motion clutch adjustment.

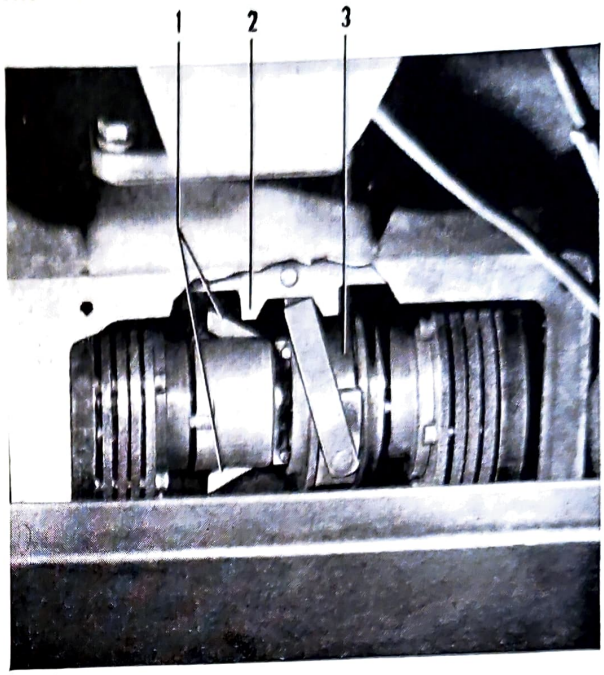
(3) If clutch adjusting lock pin (fig. 102) is not accessible, place motion control or lift control lever (depending on which clutch is being adjusted) in reverse, or lift position and crank the engine until the clutch adjusting lock pin can be reached. (See fig. 102.) Return the control lever to neutral position.

(4) Force clutch adjusting lock pin back with a screw driver (fig. 102) until the pin is clear of its hole in the clutch adjusting nut.

(5) While clutch adjusting lock pin is held back, turn the clutch adjusting nut in a clockwise direction until the next hole in the end of the clutch adjusting nut is opposite the clutch adjusting lock pin.

Note. The holes in the clutch adjusting nut are about ⅜ inch apart (center to center of holes). Turning the nut slightly to bring the next hole opposite the lock pin.

(6) Do not move the clutch adjusting nut more than one hole at a time. Usually an adjustment of one hole is sufficient.



1. *Clutch dogs.*
2. *Shifter fork stop.*
3. *Clutch shifter collar.*

Figure 103. Clutch in position to move vehicle forward (clutch dog completely covered by clutch shifter collar).

(7) Release clutch adjusting lock pin; be sure that it enters the hole in the clutch adjusting nut.

(8) Move the control lever into a fully engaged position and note whether the clutch shifter collar contacts shifter fork stop. (See fig. 103.) Move the control lever into the opposite engaged position and note whether the other side of the clutch shifter collar contacts shifter fork stop. Normal pressure on the control lever should move the clutch shifter collar against each stop.

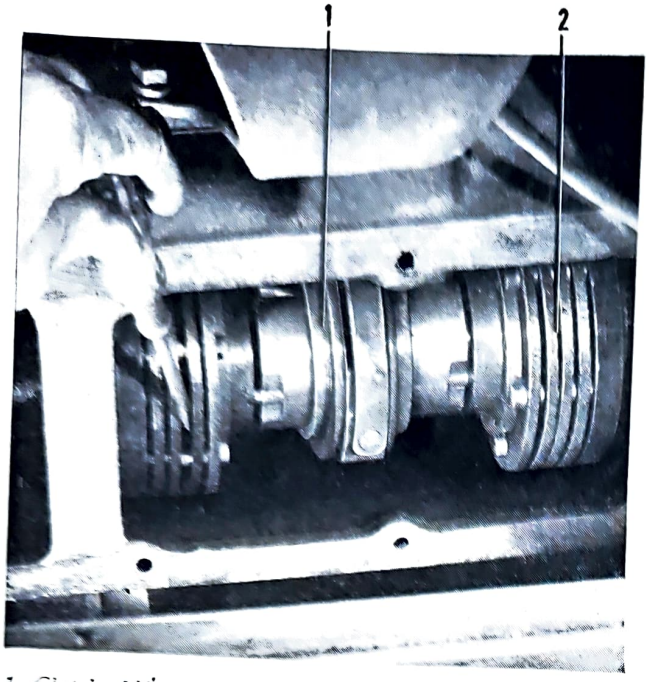
(9) If, when moved toward the *front* of the vehicle, the clutch shifter collar will go only part way toward the shifter fork stop the rear clutch is too tight. Turn the clutch adjusting nut of the *rear* clutch in a counterclockwise direction (one hole at a time) until the clutch shifter collar contacts the shifter fork stop.

(10) If the clutch shifter collar will not contact both shifter fork stops, both clutches are too tight. Turn clutch adjusting nuts in a counterclockwise direction to loosen.

Note. The clutch shifter collar moves away from and not toward the clutch it engages.

(11) The lift lowering clutch is the rear clutch on the left side of the vehicle. This clutch must never be as tight as the other three clutches.

d. Inspect Free Movement of the Clutch Plates (fig. 104).



1. Clutch shifter collar (in neutral). 2. Clutch drive plates.

Figure 104. Inspecting free movement of clutch drive plates.

(1) After the clutches have been adjusted, inspect the clutch drive plates to see whether they are free.

(2) Move control lever to neutral; clutch shifter collar should be in the center. (See fig. 104.) Insert a screw driver between the clutch drive plates and move the plates back and forth slightly. A movement of 1/32-inch is ample. Do not pry too hard against the plates or they will be broken. Inspect all plates for free movement. If the plates are not free, repeat the adjustment given in *c* above.

Note. If the plates are not free and are not adjusted, one clutch will drag while the other clutch is engaged, causing loss of engine power and burning of the plates on the clutch that is too tight.

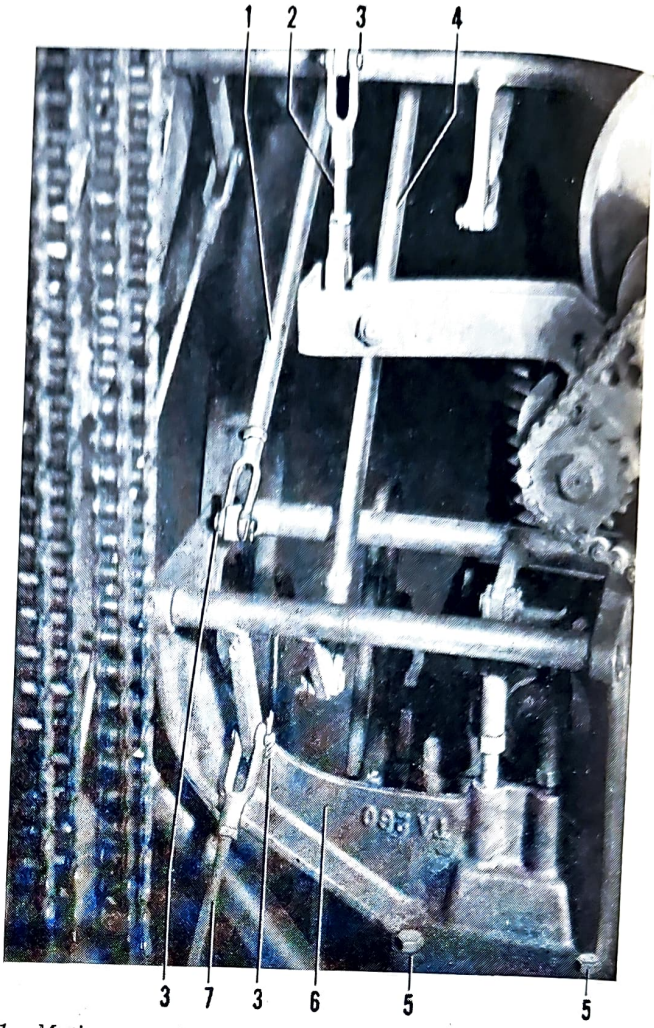
151. Removal

Note. The engine, clutch, and transmission assembly are removed as one unit.

a. Remove Engine. See paragraph 81 and perform steps *a* to *i*.

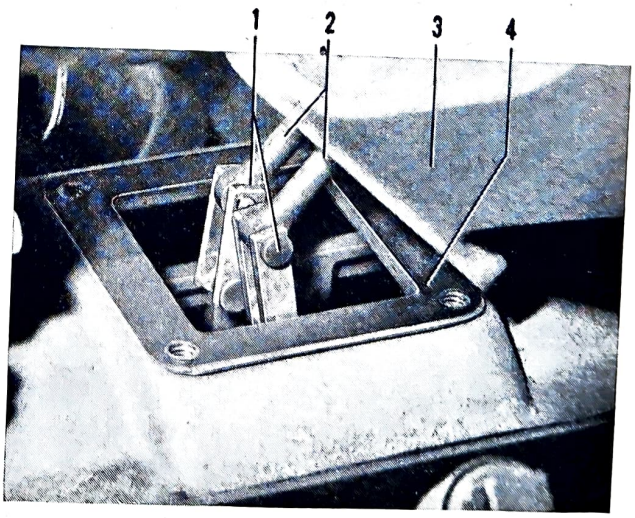
b. Remove Lift Rod Guide Bracket. (1) Remove cotter and clevis pins which secure the tilt control bracket rod, motion control rod, lift control rod, and lower tilt control rod. (See fig. 105.) Remove 3 nuts and lockwashers which secure lift rod guide bracket support stud and remove stud.

(2) Remove four cap screws and lockwashers which secure lift rod guide bracket. Remove drive belt from pulleys.



1. *Motion control rod.*
2. *Tilt control bracket rod.*
3. *Clevis pin.*
4. *Lift control rod.*
5. *Cap screws.*
6. *Lift rod guide bracket.*
7. *Tilt control lower rod.*

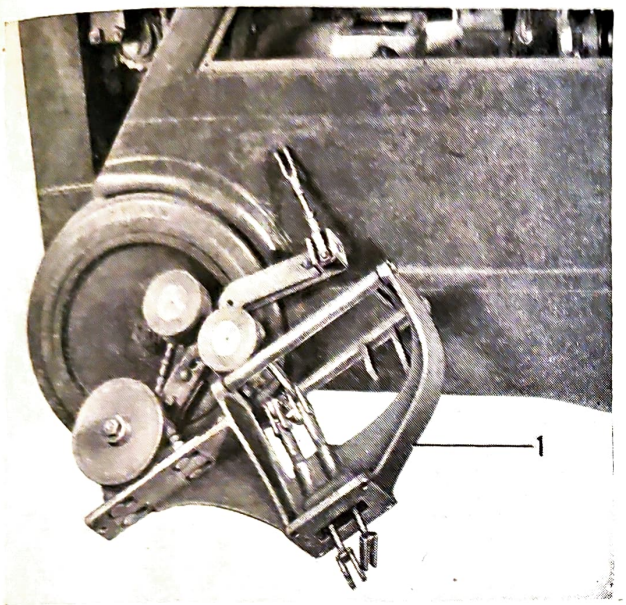
Figure 105. Control rods.



1. *Lift link pin.*
2. *Clutch shift rod.*
3. *Lift rod guide bracket.*
4. *Clutch and transmission case.*

Figure 106. Lift link pin removal.

(3) Tip left guide bracket forward far enough to disconnect the lift link pin. Remove cotter pins and link pins. (See fig. 106.) Remove the lift rod guide bracket assembly. (See fig. 107.)



1. Lift rod guide bracket assembly.
Figure 107. Lift rod guide bracket removed.

c. Remove Clutch and Engine. Remove cap screws and lockwashers which secure clutch and transmission case to frame cross tie-channel. Tie control rods up and out of the way, and pull engine, clutch, and transmission assembly out of vehicle. (See fig. 108.)

d. Remove Clutch and Transmission Case From Engine. (1) Stand engine, clutch and transmission assembly in an upright position and place wooden blocks under engine. (See fig. 109.)

(2) Remove 3 socket head set screws and cap screws which secure clutch to clutch case. (See fig. 110.)

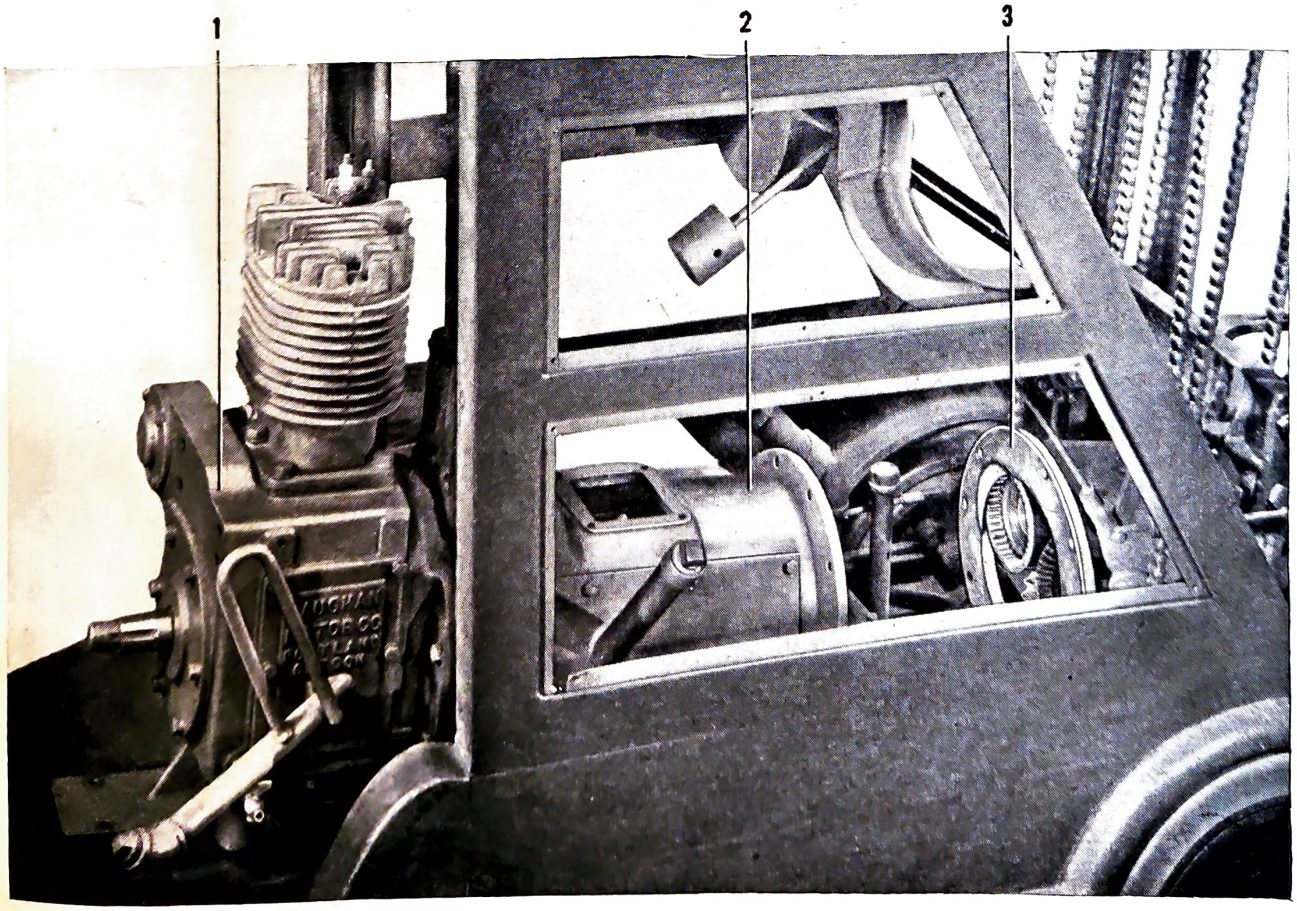
(3) Remove cap screws and lockwashers which secure clutch case to engine crankcase. Lift clutch case off clutch.

(4) Pry clutch and transmission assembly out of engine crankcase rear bearing cover. (See fig. 111.) Remove crankcase rear bearing cover key.

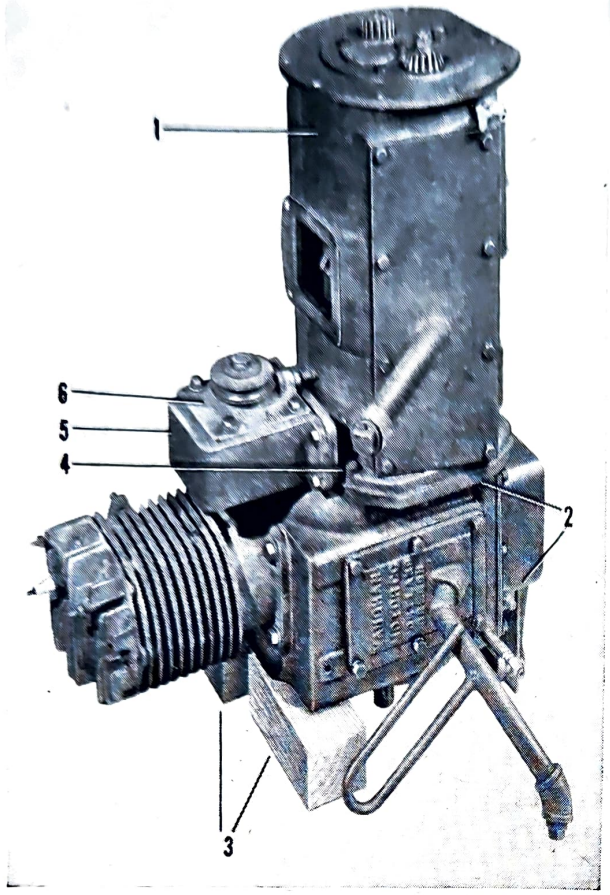
152. Disassembly

a. Remove Bevel Pinion. (See fig. 112).

(1) Remove cotter pin which secures bevel pinion

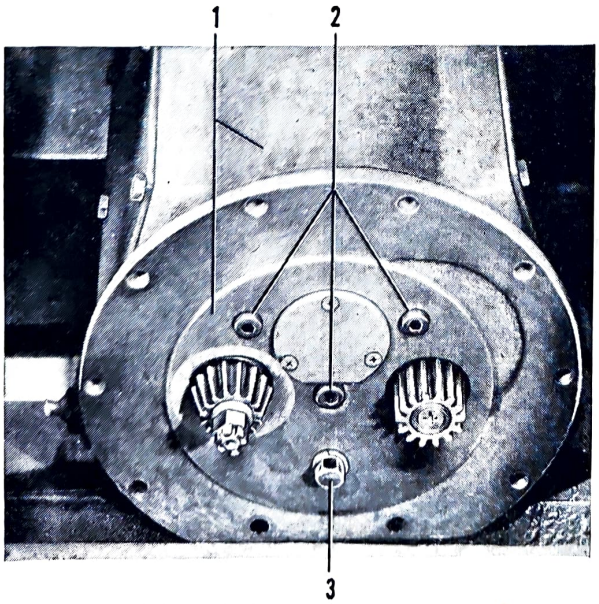


1. Engine assembly *2. Clutch and transmission case.* *3. Drive axle housing.*
Figure 108. Removal of engine assembly, clutch and transmission case.



1. *Clutch and transmission case.*
2. *Engine assembly.*
3. *Wooden blocks.*
4. *Cap screws.*
5. *Power take-off housing.*
6. *Power take-off bracket.*

Figure 109. Engine and clutch blocked for disassembly.

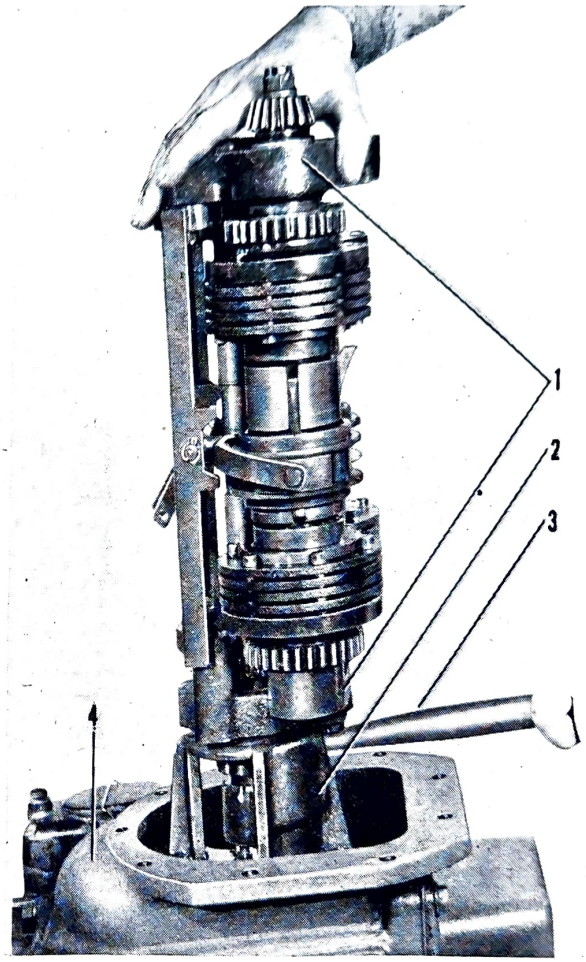


1. *Clutch and transmission case.*
2. *Socket head screws.*
3. *Cap screw.*

Figure 110. Front end of clutch assembly.

lock nut on bevel pinion. Wedge the gears to prevent them from turning. (See fig. 112.) Slide clutch shifter collar so that clutch is engaged. (See fig. 112.)

(2) Remove bevel pinion castellated nut and bevel pinion washer from shaft. Using a gear puller, remove bevel pinion from shaft. (See fig. 112.) Remove bevel pinion key from clutch shaft.



1. *Clutch and transmission assembly.*
2. *Engine crankcase rear bearing cover.*
3. *Pry bar.*
4. *Engine crankcase.*

Figure 111. Prying clutch out of engine crankcase bearing cover.

b. Remove Internal Gear Pinion (fig. 112). Unscrew internal gear pinion lock screw and remove internal gear pinion washer. Using a gear puller, remove internal gear pinion from clutch shaft. Remove internal gear pinion key from clutch shaft.

c. Remove Clutch Shifter Forks (fig. 112). (1) Remove cotter pins from each end of clutch shifter fork pin. Remove pin from clutch shifter forks and clutch bearing spacer.

(2) Remove clutch shifter forks (right and left).

(3) Remove four screws which secure the clutch bearing spacer to the front and rear clutch supports and remove bearing spacer.

d. Remove Main Drive Shaft Assembly (fig. 113). (1) Unscrew main drive shaft thrust screw and remove main drive shaft thrust plate. Remove rear and front clutch supports from main drive shaft.

(2) Lift main drive shaft assembly off the four clutch assemblies and remove two clutch shaft spacers from ends of clutch shafts.

e. Disassemble Main Drive Shaft (fig. 112). (1) Press front drive pinion off main drive shaft. The main drive shaft needle bearing race and front drive pinion thrust washer will come off the main drive shaft along with the front drive pinion. Remove key from shaft.

(2) Press drive shaft spline coupling sprocket off main drive shaft and remove key from shaft.

(3) Press rear drive pinion off main drive shaft and remove key from shaft.

f. Disassemble Front Clutch Support (fig. 112). Press two clutch shaft ball bearings out of the front clutch support. Then press main drive shaft needle bearing out of the support.

g. Disassemble Rear Clutch Support (fig. 112). (1) Remove cotter pin which secures clutch idler pinion shaft nut and unscrew clutch idler pinion shaft nut.

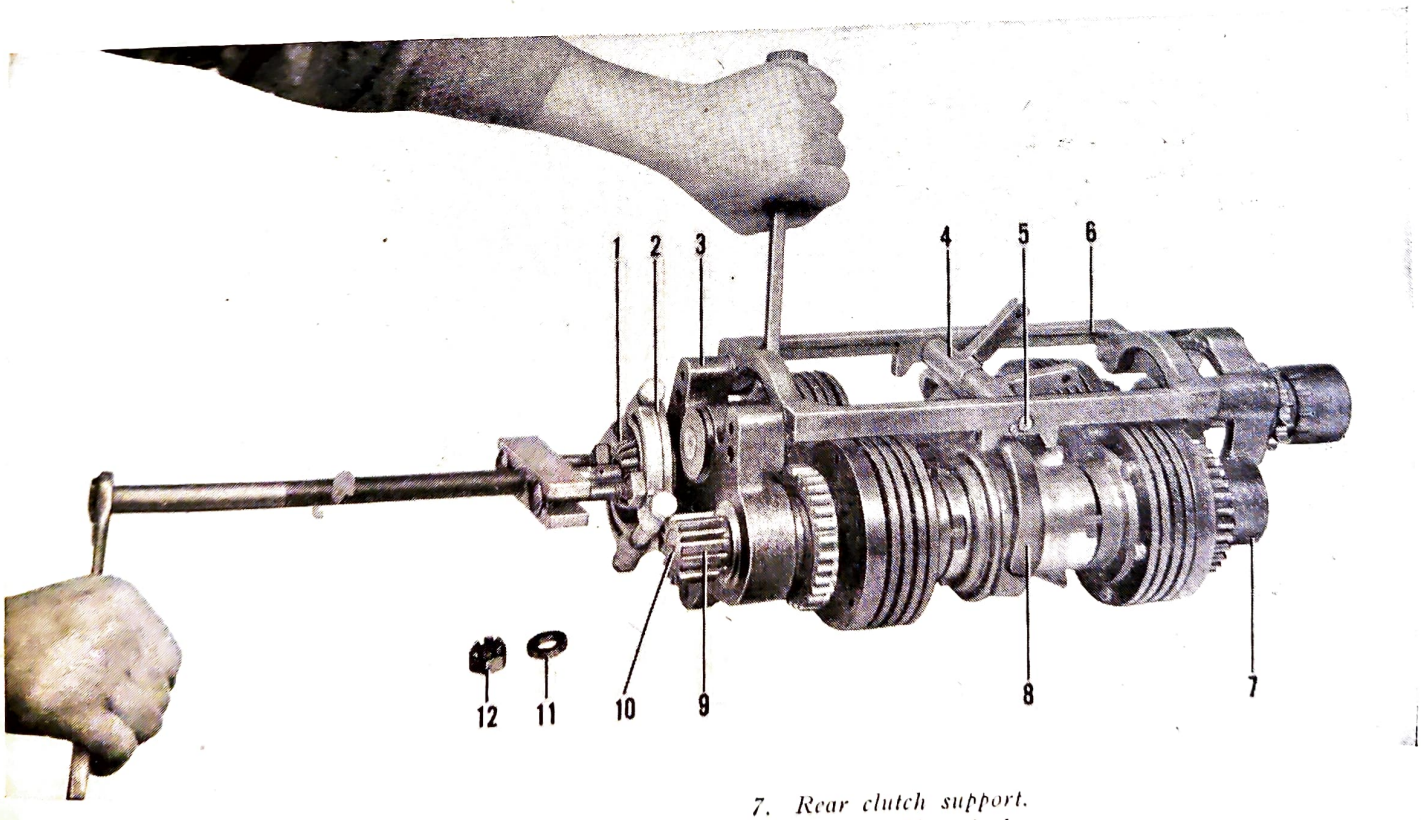
(2) Remove clutch idler pinion shaft from rear clutch support and press clutch drive pinion needle bearing out of support.

(3) Remove clutch idler pinion bearing spacer and clutch idler pinion from clutch shaft and press clutch idler pinion needle bearing out of clutch idler pinion.

h. Remove Clutch Drive Pinions. Remove clutch drive pinions with clutch drive pinion needle bearings from both clutch shafts. Press needle bearings out of drive pinions.

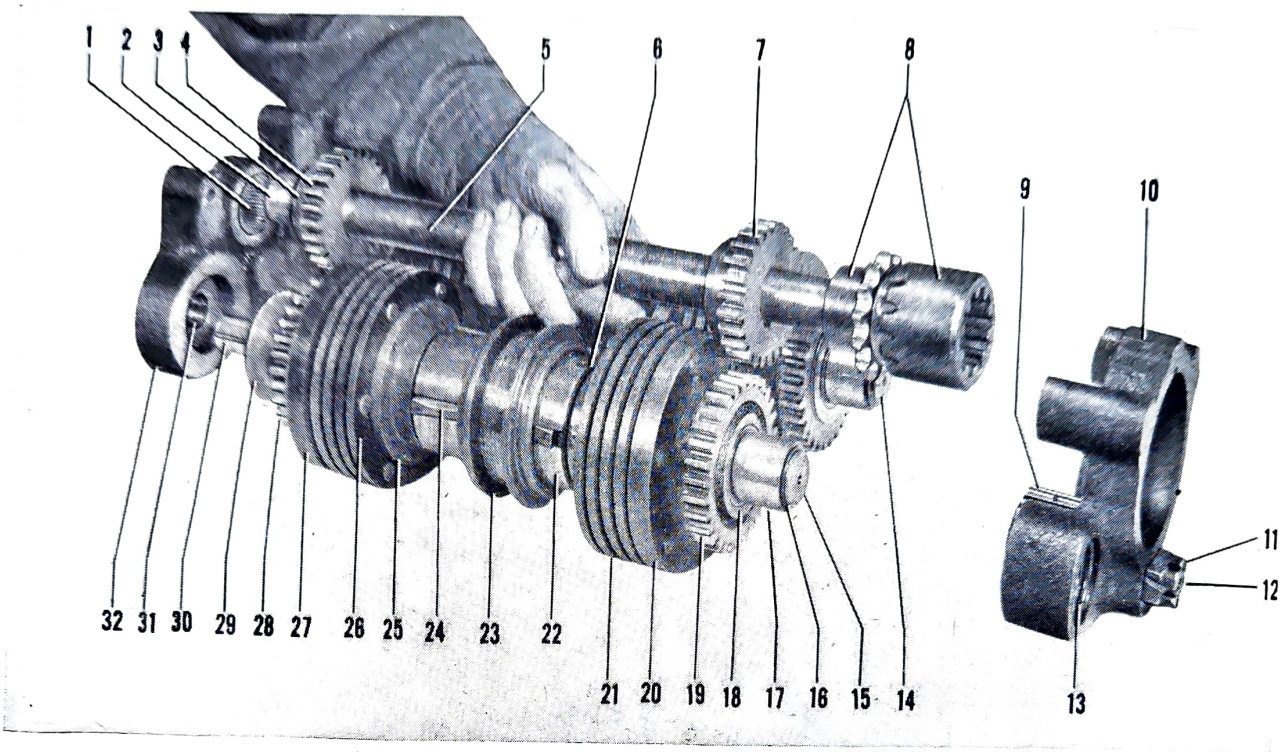
i. Pressing Clutch Driven Collar Off Clutch Shaft. (1) Drive clutch driven collar pin out of clutch driven collar and clutch shaft. (See fig. 114.) Remove lock ring which secures clutch drive pinion needle bearing race on clutch shaft.

(2) Push back on clutch adjusting lock pin and



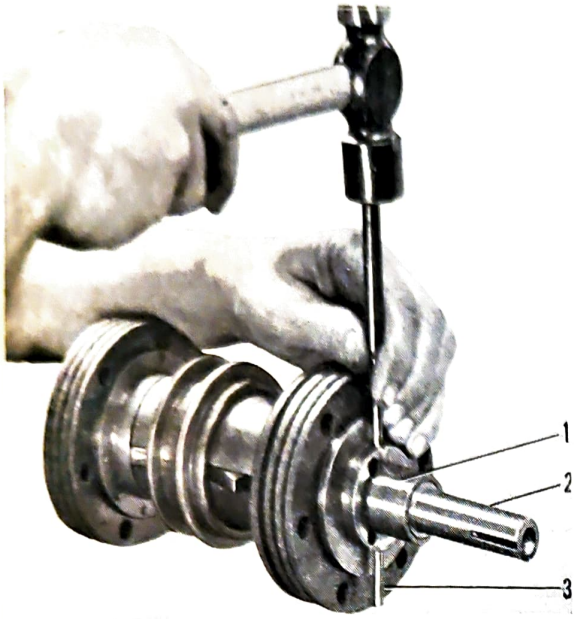
1. *Bevel pinion.*
2. *Gear puller.*
3. *Front clutch support.*
4. *Clutch shifter fork.*
5. *Clutch shifter fork pin.*
6. *Clutch support frame.*
7. *Rear clutch support.*
8. *Clutch shifter fork.*
9. *Internal gear pinion.*
10. *Internal gear pinion lock screw and washer.*
11. *Bevel pinion washer.*
12. *Bevel pinion castellated nut.*

Figure 112. Pulling bevel pinion from clutch shaft.



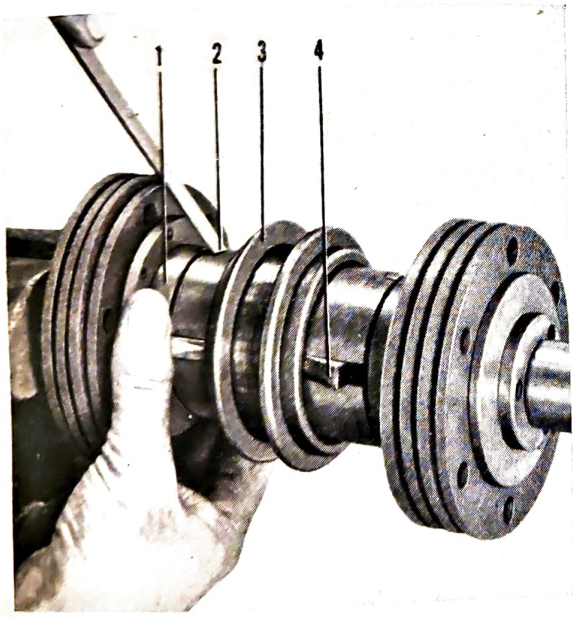
1. *Main drive shaft needle bearing.*
2. *Main drive shaft needle bearing race.*
3. *Front drive pinion thrust washer.*
4. *Front drive pinion.*
5. *Main drive shaft.*
6. *Clutch adjusting lock pin.*
7. *Rear drive pinion.*
8. *Drive shaft spline coupling sprocket.*
9. *Clutch idler pinion.*
10. *Rear clutch support.*
11. *Clutch idler pinion shaft nut.*
12. *Clutch idler pinion shaft.*
13. *Lift clutch rear bearing retainer.*
14. *Drive clutch shaft.*
15. *Lift clutch shaft.*
16. *Bearing race lock.*
17. *Clutch drive pinion needle-bearing race.*
18. *Clutch drive pinion needle bearing.*
19. *Clutch drive pinion.*
20. *Clutch drive pinion flange.*
21. *Clutch drive plate.*
22. *Clutch body.*
23. *Clutch shifter collar.*
24. *Clutch dog.*
25. *Clutch adjusting nut.*
26. *Clutch drive plate.*
27. *Clutch drive pinion flange.*
28. *Clutch drive pinion.*
29. *Clutch shaft spacer.*
30. *Clutch shaft.*
31. *Clutch shaft ball bearing.*
32. *Front clutch support.*

Figure 113. Removing main drive shaft assembly.



1. *Clutch driven collar.* 2. *Clutch shaft.*
3. *Clutch driven collar pin.*

Figure 114. Driving clutch driven collar pin cut of collar and clutch shaft.



1. *Clutch adjusting nut.* 3. *Clutch shifter collar.*
2. *Clutch adjusting lock pin.* 4. *Clutch dog.*

Figure 115. Holding clutch adjusting collar pin to free clutch adjusting nut.

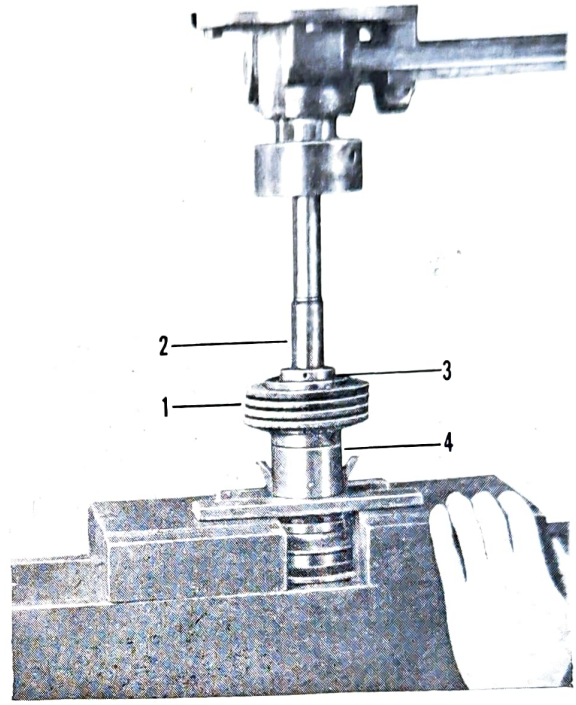
turn clutch adjusting nut until the clutch shifter collar will slide back and forth easily over the clutch dogs. (See fig. 115.)

(3) Press the clutch body, clutch driven collar and the four clutch drive and driven plates on the shaft for a distance of ⅜ inch (fig. 116).

(4) Remove the entire assembly from the press and allow the clutch body and clutch drive and driven plates to slide down the clutch shaft, rendering the clutch driven collar key accessible.

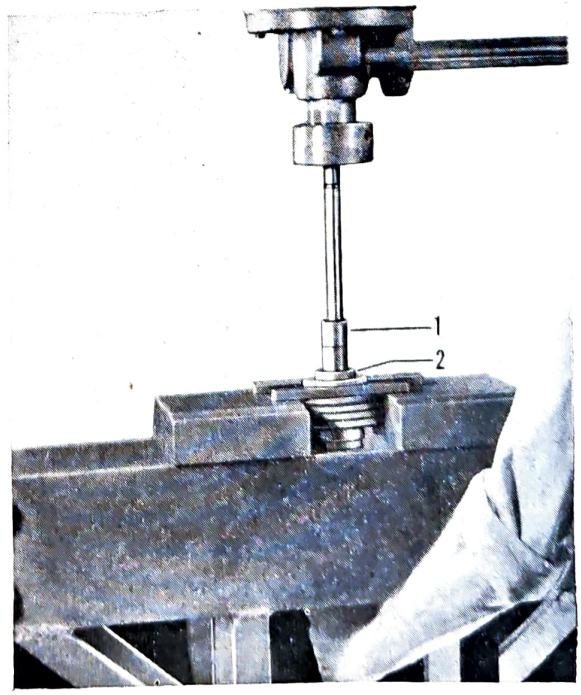
(5) Press clutch driven collar and needle bearing race off clutch. (See fig. 117.)

j. Remove Clutch Shaft (fig. 118). (1) Pull four clutch drive plates and three clutch driven



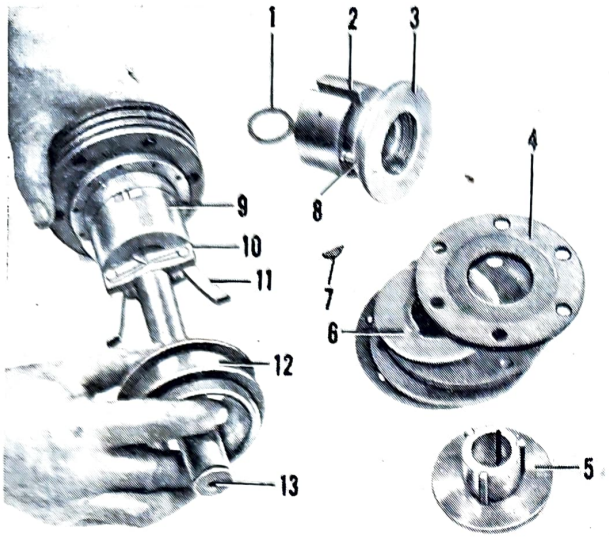
1. *Clutch drive and driven plates.* 3. *Clutch driven collar.*
2. *Clutch shaft.* 4. *Clutch body.*

Figure 116. Pressing clutch driven collar for ⅜ inch.



1. *Clutch shaft.* 2. *Clutch driven collar.*

Figure 117. Pressing clutch driven collar and needle bearing races off clutch shaft.



1. *Clutch body hardened washer.*
2. *Clutch body.*
3. *Clutch adjusting nut.*
4. *Clutch drive plates.*
5. *Clutch driven collar.*
6. *Clutch driven plates.*
7. *Clutch driven collar key.*
8. *Clutch adjusting lock pin*
9. *Clutch body.*
10. *Wire.*
11. *Clutch dog.*
12. *Clutch shifter collar.*
13. *Clutch shaft.*

Figure 118. Disassembly of clutch shaft.

plates off the clutch shaft. Remove clutch driven collar key from clutch shaft.

(2) Pull clutch body, clutch body hardened washer, and clutch shifter collar off clutch shaft.

(3) Cut wire holding clutch dog pin and remove pin and clutch dog. Press back clutch adjusting lock pin and unscrew clutch adjusting nut from clutch body. Remove clutch adjusting lock pin and clutch adjusting lock spring.

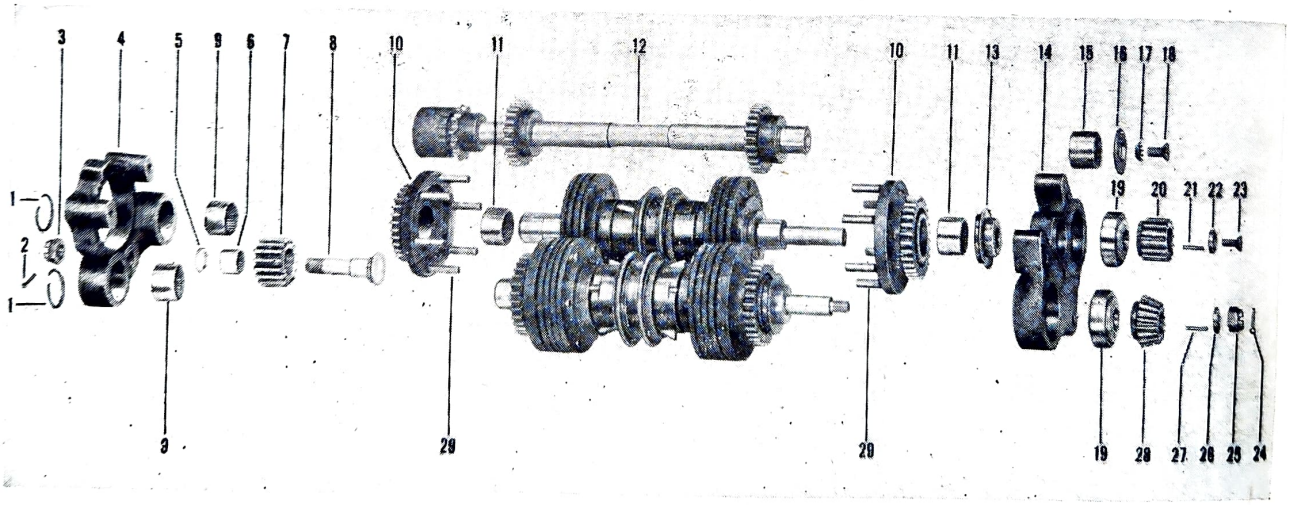
(4) Repeat steps (1), (2), (3) at opposite end of shaft and on the other clutch.

153. Inspection and Repair

a. Inspect the main drive shaft needle bearing, clutch idler pinion needle bearing, clutch drive pinion needle bearing, and clutch shaft ball bearings for smooth operation by turning the bearing in its race and noting whether the bearing turns smoothly without noise. Do not spin the bearings. Do not use compressed air to clean bearings. Wash the bearings in solvent, dry cleaning, until all oil is removed.

b. Inspect clutch body hardened washer for scoring and wear.

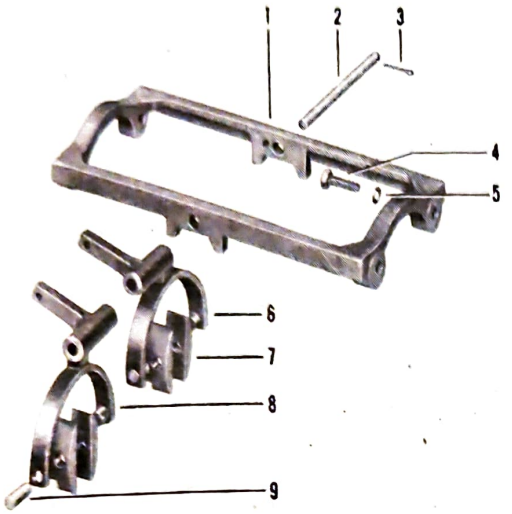
c. See that all gears are in good condition, with no evidence of scored or chipped teeth.



1. *Drive pinion needle bearing snap ring.*
2. *Idler pinion shaft pin.*
3. *Idler pinion shaft nut.*
4. *Rear clutch support.*
5. *Idler pinion bearing spacer.*
6. *Idler pinion needle bearing.*
7. *Idler pinion.*
8. *Idler pinion shaft.*
9. *Support bearing.*
10. *Drive pinion.*
11. *Clutch shaft bearing.*
12. *Main drive shaft assembly.*
13. *Main drive shaft spacer.*
14. *Front clutch support.*
15. *Front support needle bearing.*
16. *Main drive shaft thrust plate.*
17. *Main drive shaft thrust screw washer.*
18. *Main drive shaft thrust screw.*
19. *Clutch shaft ball bearing.*
20. *Internal gear pinion.*
21. *Internal gear pinion key.*
22. *Internal gear pinion lock screw washer.*
23. *Internal gear pinion lock screw.*
24. *Clutch shaft cotter pin.*
25. *Bevel pinion castellated nut.*
26. *Bevel pinion washer.*
27. *Bevel pinion key.*
28. *Bevel pinion.*
29. *Drive pinion pin.*

Figure 119. Clutch and transmission.

d. Replace clutch drive and driven plates if worn. Replace burned clutch drive plates. Inspect the friction surface of the clutch driven plates for



1. *Clutch support frame.*
2. *Shifter fork shaft.*
3. *Cotter pin.*
4. *Clutch support frame screw.*
5. *Washer.*
6. *Shifter fork—left.*
7. *Shifter fork shoe.*
8. *Shifter fork—right.*
9. *Shifter fork shoe pin.*

Figure 120. Clutch support frame, shifter forks, fork shoes, and pins.

smoothness, freedom from scores, good condition, and absence of grooves.

e. The clutch shifter yokes must not be worn and must be a good fit on the clutch shifter collar.

154. Assembly

a. Assemble Clutch Shaft (fig. 122). (1) Install clutch adjusting lock pin and spring in clutch body. Press back on the lock pin and screw the clutch adjusting nut on the clutch body. Install clutch dog in the clutch body and secure the dog to the body with the clutch dog pin. Secure pin with the clutch dog pin wire.

(2) Slide the clutch shifter collar, clutch body hardened washer and clutch body onto the clutch shaft.

(3) Insert clutch driven collar key in keyway of clutch shaft. Then slide four clutch drive plates and three clutch driven plates on the clutch shaft. One clutch driven plate must be between each pair of clutch drive plates.

(4) Repeat steps (1), (2), and (3) at opposite end of shaft and on other clutch.

b. Pressing Clutch Driven Collar on Clutch Shaft (fig. 122). (1) Press clutch driven collar and needle bearing race on clutch shaft. Be sure clutch driven collar is on key in shaft.

(2) Install clutch drive pinion needle bearing race lock ring on clutch shaft and drive clutch driven collar pin through clutch driven collar and clutch shaft.

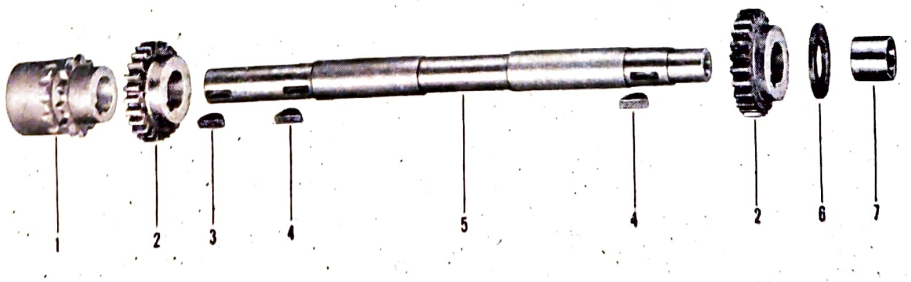
c. Install Clutch Drive Pinions (fig. 122). Press clutch drive pinion needle bearings into clutch drive pinions. Push clutch drive pinions on clutch shaft.

d. Assemble Rear Clutch Support (fig. 119). (1) Press clutch idler pinion needle bearing into clutch idler pinion. Slide clutch idler pinion on clutch shaft and slide clutch idler pinion bearing spacer on shaft.

(2) Press clutch drive pinion needle bearing into rear clutch support. Then install clutch idler pinion shaft in yoke. Install the clutch idler pinion shaft nut and secure with a cotter pin.

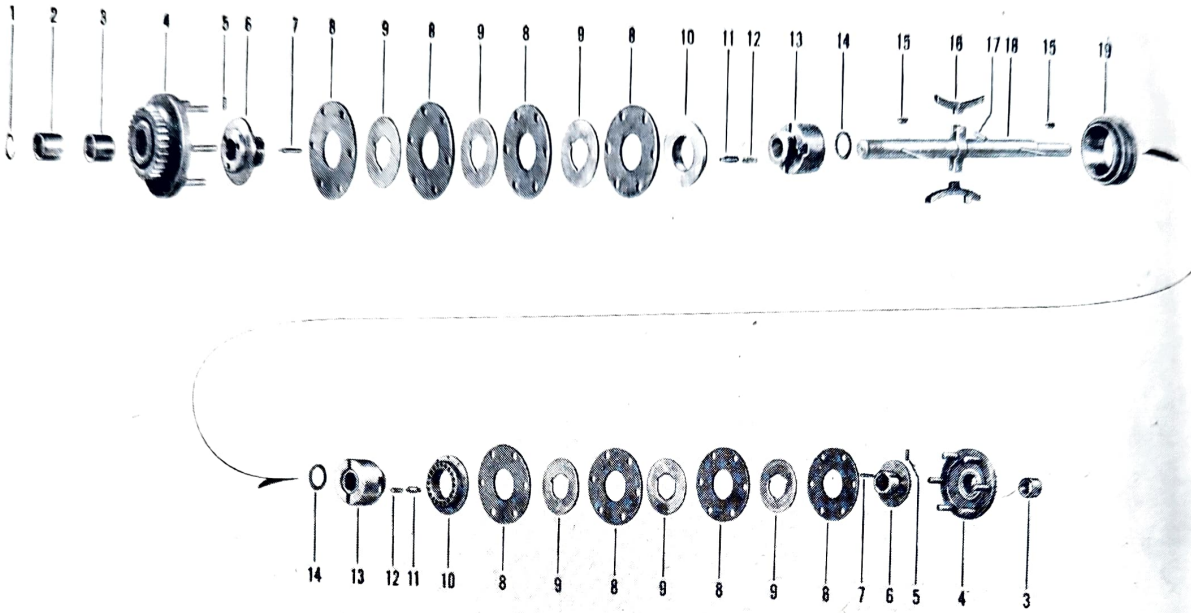
e. Assemble Front Clutch Support (fig. 119). Press main drive shaft spacer into front clutch support. Press two clutch shaft ball bearings into yoke.

f. Assemble Main Drive Shaft (fig. 121).



1. *Spline coupling and sprocket.*
2. *Drive pinion.*
3. *Drive shaft Woodruff key.*
4. *Drive shaft Woodruff key.*
5. *Main drive shaft.*
6. *Front drive pinion thrust washer.*
7. *Needle bearing race.*

Figure 121. Transmission main drive shaft assembly.



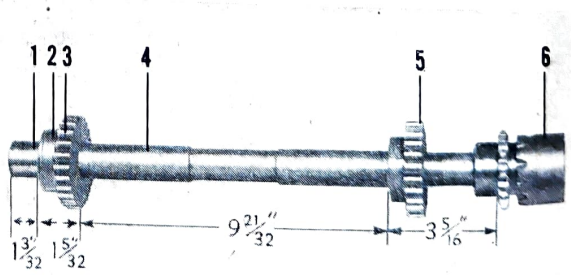
1. *Clutch rear support needle bearing race snap ring.*
2. *Clutch rear support needle bearing race.*
3. *Clutch drive pinion needle bearing race.*
4. *Clutch drive pinion assembly.*
5. *Clutch driven collar pin.*
6. *Clutch driven collar.*
7. *Clutch driven collar spline key.*
8. *Clutch drive plate (fibre).*
9. *Clutch driven plate.*
10. *Clutch adjusting nut.*
11. *Clutch adjusting nut lock pin.*
12. *Clutch adjusting nut lock spring.*
13. *Clutch body.*
14. *Clutch body washer.*
15. *Clutch driven collar Woodruff key.*
16. *Clutch dog.*
17. *Clutch dog pin.*
18. *Clutch shaft (female thread end).*
19. *Clutch shifter collar.*

Figure 122. Clutch shaft assembly.

(1) Install rear drive pinion key in keyway of main drive shaft. Then press rear drive pinion on main drive shaft and key.

(2) Install drive shaft spline coupling and sprocket key in keyway of main drive shaft. Then press drive shaft splice coupling and sprocket on main drive shaft so that it is $3\frac{5}{16}$ inches from the rear drive pinion. (See fig. 123.)

(3) Install front drive pinion key in keyway of main drive shaft. Press front drive pinion, front drive pinion thrust washer, and main drive shaft spacer on main drive shaft.



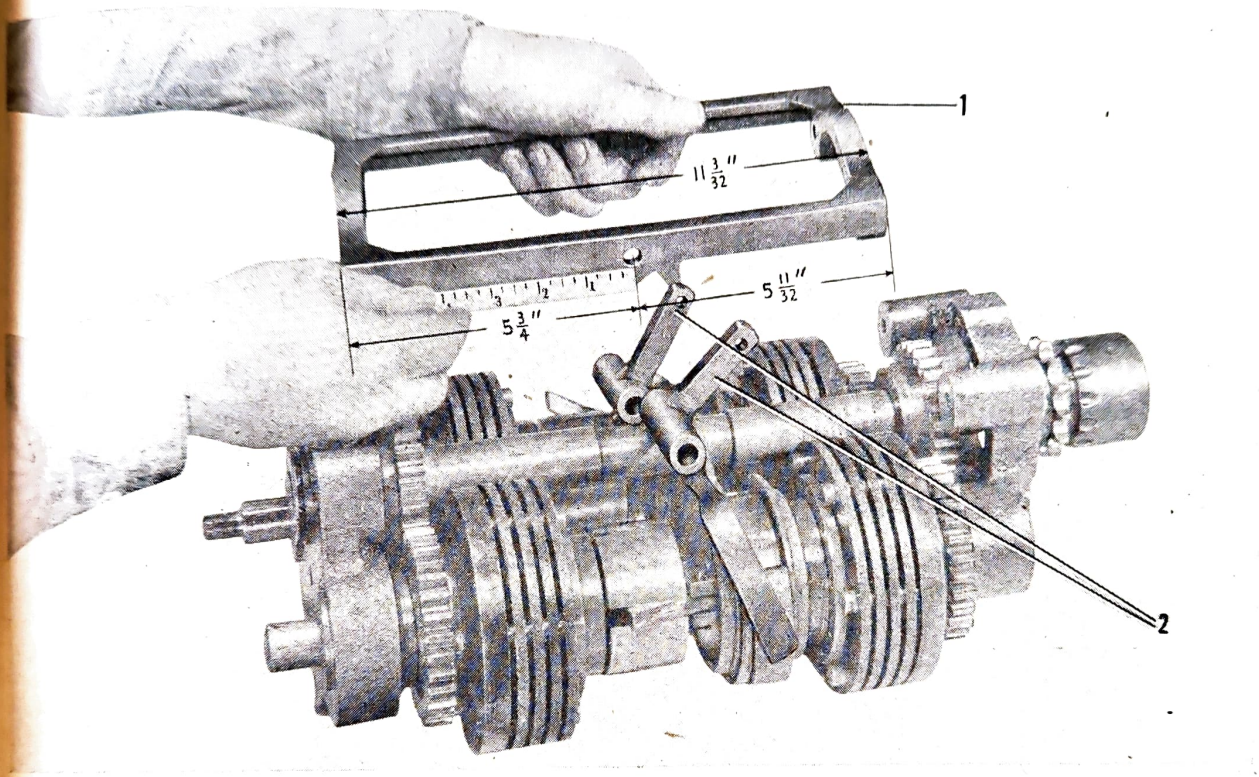
1. *Main drive shaft needle bearing race.*
2. *Front drive pinion thrust washer.*
3. *Front drive pinion.*
4. *Main drive shaft.*
5. *Rear drive pinion.*
6. *Drive shaft spline coupling sprocket.*

Figure 123. Assembling rear drive pinion and drive shaft spline coupling sprocket on main drive shaft.

g. Install Main Drive Shaft Assembly (fig. 119). (1) Slide two clutch shaft bearings on ends of clutch shafts. Then lift main drive shaft assembly onto the four clutches.

(2) Install rear and front clutch supports on main drive shaft. Install main drive shaft thrust plate and main drive shaft thrust screw and washer.

h. Install Clutch Shifter Forks (fig. 120).



1. *Clutch support frame.* 2. *Clutch shifter forks.*

Figure 124. Measuring clutch support frame before assembling.

(1) Install clutch shifter forks (right and left) on clutch shifter collars.

(2) Install clutch bearing spacer, being certain that it is installed in the correct manner and not reversed. (See fig. 124.) Install four screws which secure the clutch support frame to the front and rear clutch supports.

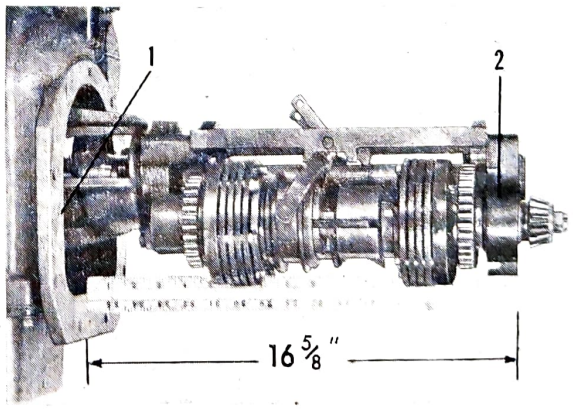
(3) Install clutch shifter fork pin through the clutch support frame and clutch shifter forks. Then install cotter pins at both ends of the clutch shifter fork pin.

i. Install Internal Gear Pinion (fig. 119). (1) Install internal gear pinion key in clutch shaft, and press internal gear pinion on clutch shaft. Install internal gear pinion washer and secure to the shaft with internal gear pinion lock screw.

(2) Wedge the gears so that they will not turn and shift the clutch shifter collar so that the clutch is engaged. Install bevel pinion castellated nut and washer and tighten securely; install cotter pin to hold nut in place.

155. Installation

a. Install Clutch on Engine (fig. 111). (1) Install crankcase rear bearing cover key in keyway of cover and install clutch assembly so that clutch yoke keyway is over key.



1. *Engine crankcase flange.* 2. *Front clutch support.*

Figure 125. Measuring height of clutch from crankcase flange to top of front clutch support.

(2) Inspect height of clutch as shown in figure 125. Height should be 16⅝ inch; if it is not, assembly is incorrect.

(3) Install clutch and transmission case and se-

cure to engine crankcase with cap screws and lockwashers.

(4) Install three socket head set screws and cap screw which secure clutch to clutch case. (See fig. 110.)

b. INSTALL CLUTCH AND ENGINE (fig. 108). Install clutch with engine assembly in vehicle and secure clutch housing to frame across tie channel with cap screws and lockwashers.

c. INSTALL LIFT ROD GUIDE BRACKET (fig. 107). (1) Install lift rod guide bracket on clutch housing. Then tip lift rod guide bracket forward far enough to connect the lift link pins. Install link pins and secure with cotter pins.

(2) Install drive belt on pulleys. Install four cap screws and lockwashers which secure lift rod bracket to clutch housing.

(3) Adjust deflection of drive belt. (See par. 150.)

(4) Install lift rod guide bracket support stud and secure with three nuts and lockwashers. Connect tilt control bracket rod, motion control rod, lift control rod, and tilt control rod lower. Then install clevis and cotter pins which secure these rods in place. (See fig. 105.)

d. ENGINE CONNECTIONS. See paragraph 85 and perform steps *a* to *f*.

e. ADJUST CLUTCH AND TIME ENGINE. See paragraph 150 and adjust clutch. See paragraph 63 and time engine.

Section XV. MAST ASSEMBLY

156. General

a. The telescoping inner and outer masts are located on the front of the vehicle and the load carriage; lift forks, back rest, lift chain sprockets, and tilt racks are secured to the masts.

b. Movement of the lift control lever causes the lift mechanism to operate the lift chains over their sprockets and the load on the lift forks is raised or lowered.

c. Movement of the tilt control lever causes the tilt mechanism to operate the tilt racks and the load on the lift forks is tilted forward or backward.

157. Removal

a. REMOVE DRIVE WHEELS. See paragraph 69.

b. DISCONNECT TILT STOP ROD. Remove cotter and clevis pin which secures the tilt stop rod clevis to the mast.

c. DISCONNECT LIFT CHAINS. (1) Lower carriage onto a wooden block or jack to take the carriage weight off the lift chains.

(2) Slide master link pin locks off master link pins. Remove master link pin links and pull master links with pins out of lift chains and chain tension spring bolts.

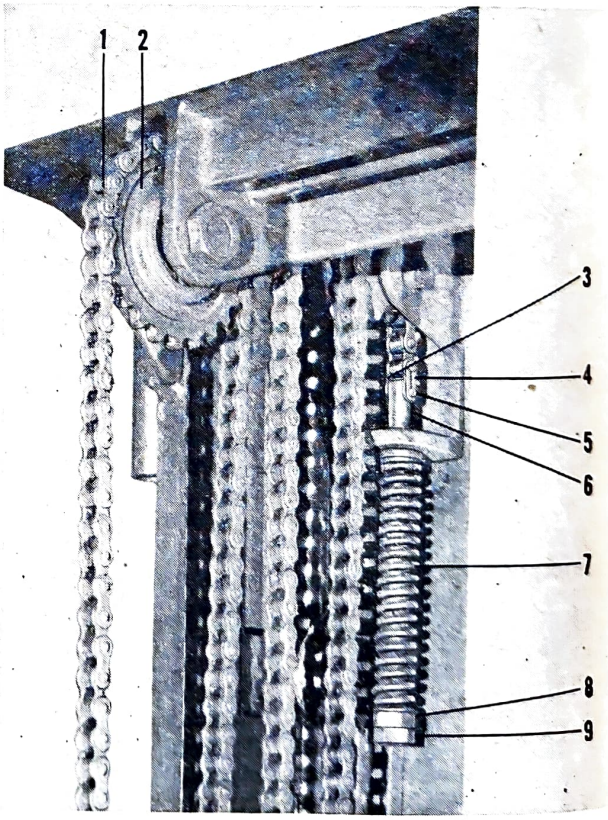
(3) Press inward on brake shoe retainer springs and remove brake shoe retainer pins, cups and springs from both sides of the brake shoe.

Note. This will give access to the outer mast support bolt. (See fig. 127.)

(4) Remove two outer mast support bolt nuts. Remove the two outer mast support bolts and remove mast assembly.

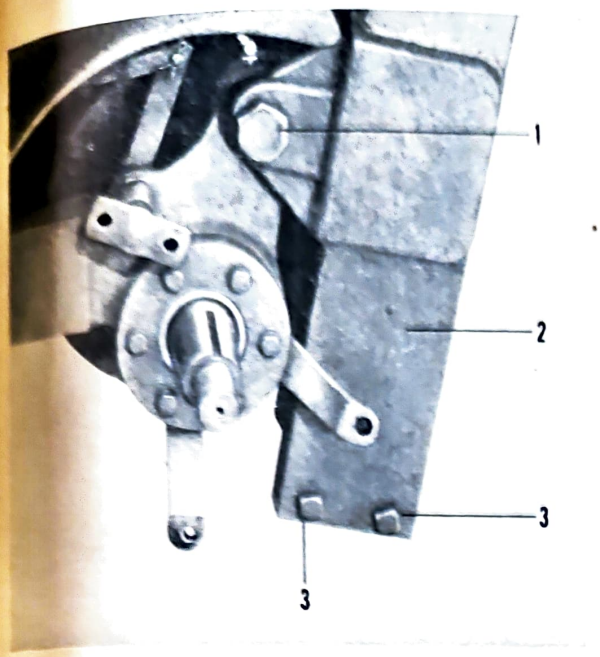
158. Disassembly

a. REMOVE BACK REST (fig. 128). Drive the back rest assembly out of the carriage with a sledge hammer.



1. *Lift chain.*
2. *Carriage idler sprocket.*
3. *Master link.*
4. *Master link pin lock.*
5. *Master link pin.*
6. *Chain tension spring bolt.*
7. *Chain tension spring.*
8. *Nut.*
9. *Lock nut.*

Figure 126. Carriage idler sprocket and lifting chain tension spring.



1. *Outer mast support bolt.*
2. *Outer mast.*
3. *Lower spacer bolt for outer mast.*

Figure 127. Outer mast support bolt.

b. Remove Carriage (fig. 128). (1) Remove nut and lock nut from chain tension spring bolt and remove chain tension spring.

(2) Remove the cotter pins in the tilt bracket pins. Remove the tilt bracket pins which secure the tilt racks to the masts. Remove both tilt racks.

(3) Remove four inner mast spacers to inner mast bolts, nuts and lockwashers which secure lift sprocket supporting beam to inner mast and inner mast spacer. Remove inner mast spacer assembly. (See fig. 129.)

(4) Remove carriage from the masts. Remove eight bolts, nuts, and lockwashers which secure lift sprocket supporting beam to inner mast. Remove bracket. (See fig. 130.)

c. Disassemble Carriage (figs. 131 and 132).

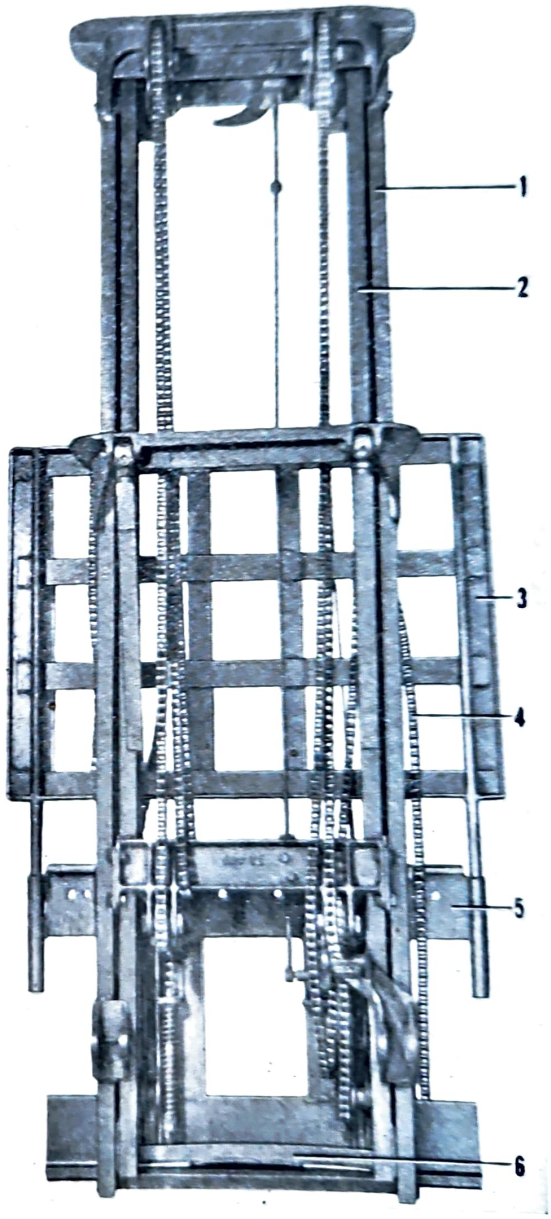
(1) Lift carriage shoes (right and left) from carriage shoe pins. Unscrew both carriage idler sprocket shaft lubrication fittings. Remove both carriage idler sprocket shaft nuts. Remove carriage idler sprocket shafts from sprockets and remove both carriage idler sprockets.

(2) Loosen carriage stop pin lock nut and remove carriage stop pin nut. Loosen set screw in carriage stop pin collar and remove carriage stop pin and carriage stop pin collar.

(3) Loosen both chain adjusting bolt lock nuts and remove the chain adjusting bolt nuts. Unscrew both chain adjusting bolts from carriage.

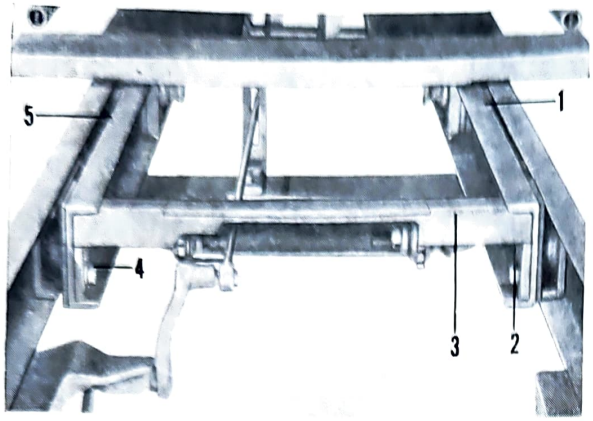
d. Disassemble Lift Sprocket Supporting Beam (Lower) for Inner Mast (fig. 130). Remove lift sprocket shaft nuts. Remove lift sprocket shafts from sprockets and lift sprocket supporting beam. Remove inner mast lift sprockets. Pry bearing retaining rings out of sprockets and remove lift sprocket bearing and lift sprocket spacers from sprockets.

e. Disassemble Lift Sprocket Supporting Beam for Outer Mast (fig. 130). Remove bolt and nut which secures outer mast stop bracket to lift sprocket supporting beam and remove outer mast stop bracket. Remove lift sprocket shaft nuts and remove sprocket shafts from sprockets and supporting beam. Remove outer mast lift sprocket



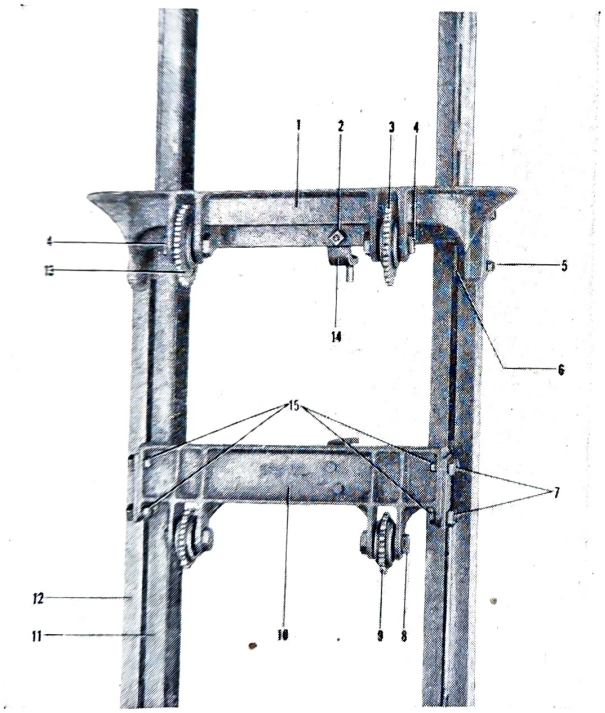
1. *Outer mast.*
2. *Inner mast.*
3. *Back rest.*
4. *Lift chain.*
5. *Carriage.*
6. *Inner mast spacer.*

Figure 128. Mast assembly removed.



1. *Inner mast.*
2. *Inner mast spacer cap screw.*
3. *Inner mast spacer.*
4. *Inner mast spacer cap screw.*
5. *Inner mast.*

Figure 129. Inner mast spacer—installed.



1. *Lift sprocket supporting beam for outer mast.*
2. *Outer mast stop bracket bolt and nut.*
3. *Outer mast lift sprocket.*
4. *Lift sprocket shaft.*
5. *Outer mast guide shoe cap screw.*
6. *Outer mast guide shoe.*
7. *Nut.*
8. *Lift sprocket shaft.*
9. *Inner mast lift sprocket.*
10. *Lift sprocket supporting beam for inner mast.*
11. *Inner mast.*
12. *Outer mast.*
13. *Outer mast lift sprocket.*
14. *Outer mast stop bracket.*
15. *Bolts.*

Figure 130. Lift sprocket supporting beams for inner mast and outer mast—installed.

assemblies. Pry bearing retaining rings out of sprockets and remove lift sprocket bearings and lift sprocket spacers from sprockets.

f. Remove Lift Stop Rod. Remove cotter pin at lower end of lift stop rod and remove lift stop rod from masts. Remove lift stop rod collar set screw and slide collar off rod.

g. Remove Outer Mast Guide Shoes (fig. 130). (1) Remove four cap screws which secure outer mast guide shoes and remove shoes.

Note. The supporting beam is welded to the outer mast and can only be removed by cutting it loose.

(2) Remove inner masts from outer masts and remove inner mast guide shoes from inner mast guide shoe pins.

h. Disassemble Masts (fig. 130). Remove inner mast lift sprocket shaft nut and remove shaft and sprocket. Repeat procedure on outer mast lift sprockets. Drive pin out of inner mast hook and supporting beam and remove hook.

Note. The upper supporting beam for inner mast is welded on the inner mast. The outer mast support brackets (right and left) are welded in place. The outer mast stop bracket is welded in place.

159. Inspection and Repair

Inspect chains for wear. If any link appears weak install a master link as instructed in paragraph 78. Inspect sprockets for wear, scoring, and looseness on their pins; replace loose or worn sprockets. See that all threads are in good condition, not mashed or crossed; if necessary, straighten threads with a thread die.

160. Assembly

a. Assemble Masts (fig. 130). Install inner mast hook on inner mast and drive inner mast hook pin through hook and inner mast. Install inner mast lift sprocket and push inner mast lift sprocket shaft through sprocket and mast. Install and tighten lift sprocket shaft nut.

b. Install Outer Mast Guide Shoes (fig. 130). Install inner mast guide shoes on inner mast guide shoe pins. Then push inner mast into outer masts. Install outer mast guide shoes and secure to the outer mast with four cap screws.

c. Install Lift Stop Rod. Slide lift rod stop collar on lift stop rod and install lift stop rod collar set screw. Do not tighten set screw until after masts have been installed and the correct position can be determined. Install lift stop rod on masts and secure lower end of rod to masts with a cotter pin.

d. Assemble Lift Sprocket Supporting Beam for Outer Mast (fig. 130). Install lift sprocket bearings in sprockets and secure with bearing retainer rings. Install lift sprocket spacers. Install outer mast lift sprockets and insert lift sprocket shaft through sprockets and bracket. Install the lift sprocket shaft nuts and tighten securely. Install outer mast stop bracket and secure to supporting beam with bolt and nut.

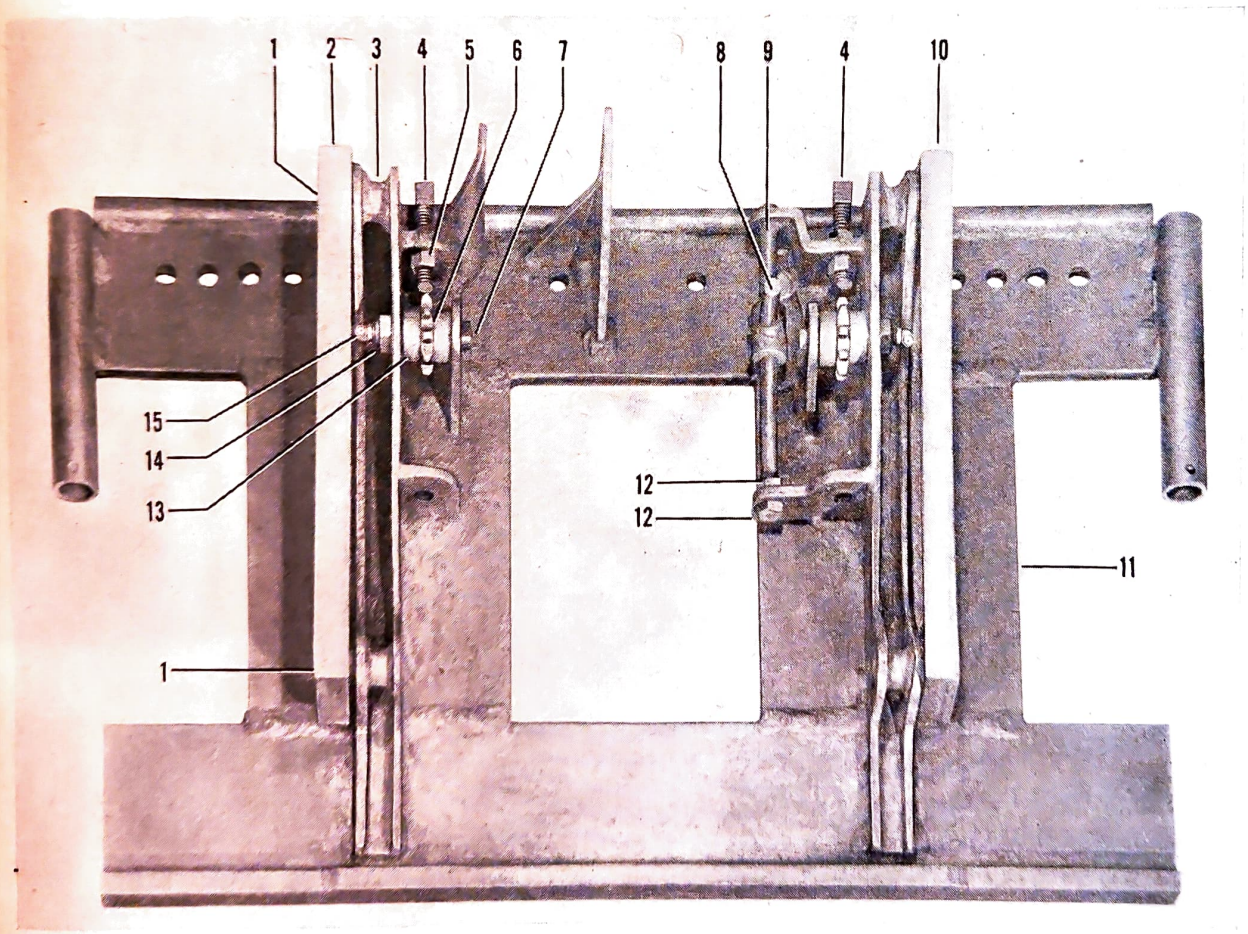
e. Assemble Lift Sprocket Supporting Beam (Lower) for Inner Mast (fig. 130). Install lift sprocket bearings in sprockets and secure with bearing retainer rings. Install lift sprocket spacers. Install inner mast lift sprockets and secure to supporting beam with lift sprocket shafts. Install lift sprocket shaft nuts and tighten securely.

f. Assemble Carriage (figs. 131 and 132). (1) Screw chain adjusting bolt locknuts on chain adjusting bolts, and screw bolts into carriage. Install chain adjusting bolt nuts, and tighten the locknuts.

(2) Install carriage stop pin collar and stop pin locknut on carriage stop pin. Install stop pin on carriage. Tighten set screw slightly and adjust the stop after mast assembly is installed. Install carriage stop pin nut and tighten locknut.

(3) Install carriage idler sprockets and secure to the carriage with carriage idler sprocket shafts. Install and tighten securely with carriage idler sprocket shaft nuts. Install carriage idler sprocket shaft lubrication fittings and place right and left carriage shoes on their carriage shoe pins.

g. Install Carriage (fig. 128). (1) Install



1. *Carriage shoe pin.*
2. *Carriage shoe, left.*
3. *Carriage bracket, left (welded).*
4. *Chain adjusting bolt.*
5. *Chain adjusting bolt nut.*
6. *Carriage idler sprocket.*
7. *Carriage idler sprocket pin.*
8. *Carriage stop pin collar.*
9. *Carriage stop pin.*
10. *Carriage shoe, right.*
11. *Carriage.*
12. *Carriage stop pin nut.*
13. *Carriage idler sprocket bushing.*
14. *Carriage idler sprocket pin nut.*
15. *Lubrication fitting.*

Figure 131. Inside of carriage assembly.

lower lift sprocket supporting beam for inner mast and secure to inner mast with eight bolts, nuts, and lockwashers. Install carriage on masts.

(2) Install inner mast spacer on inner mast with bolts, nuts, and lockwashers.

(3) Install both tilt racks and secure to masts with tilt bracket pins. Secure tilt bracket pins with cotter pins.

(4) Install chain tension spring on chain tension spring bolt; install chain tension spring bolt locknut on bolt. Install bolt on carriage; install chain tension spring bolt nut and tighten the locknut.

h. Install Back Rest (fig. 128). Drive back rest into guides provided for it in carriage.

161. Installation

a. Connect Lift Chains (fig. 127). (1) Install mast assembly on vehicle and secure with two outer mast support bolts.

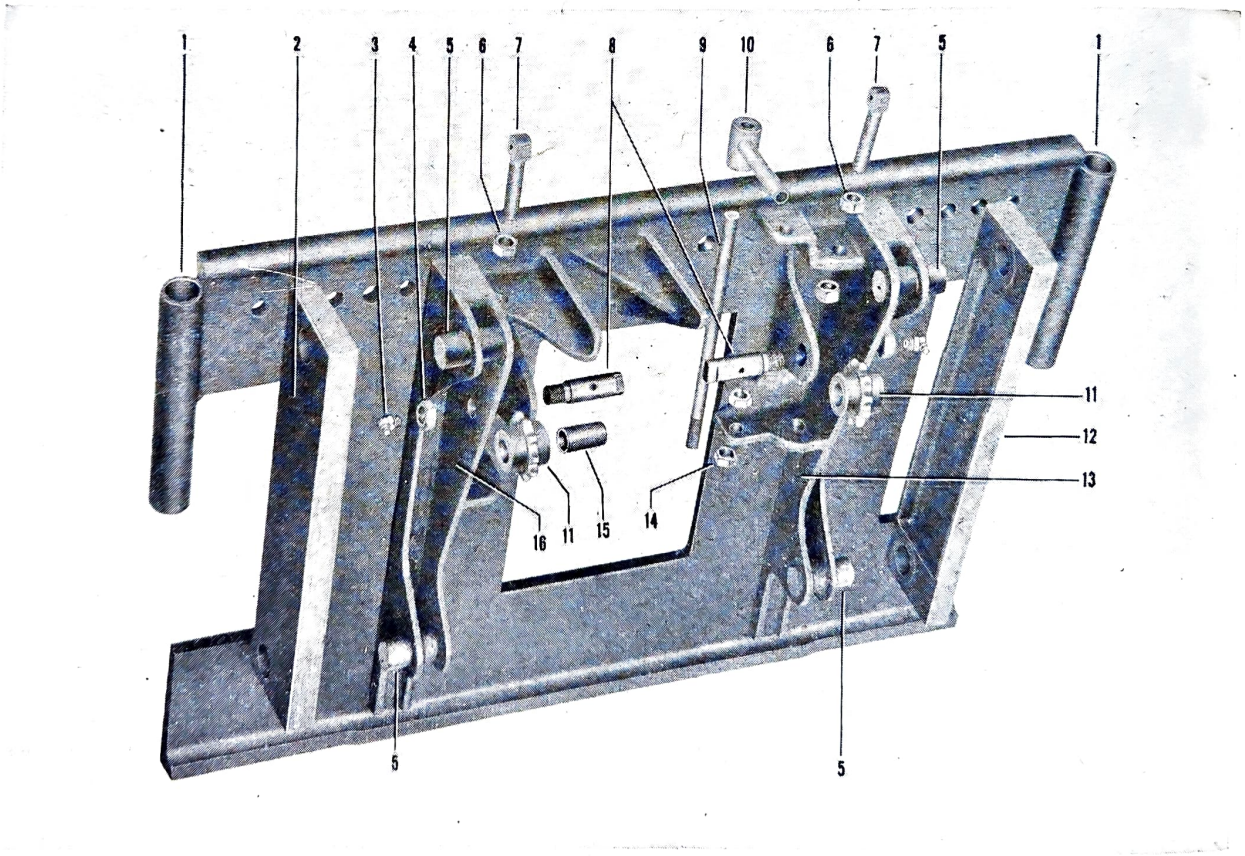
(2) Install brake shoe retainer springs, cups, and retainer pins on both sides of brake shoe.

(3) Place carriage on a wooden support so that lift chains can be connected and so that there will be no weight on the chains. Connect end of lift chain to chain tension spring bolt with master link with pins. Place master link pin link on opposite side of chain and slide master link pin locks on master link pins.

b. Connect Tilt Stop Rod. Attach tilt stop rod clevis to the mast and secure with clevis and cotter pins.

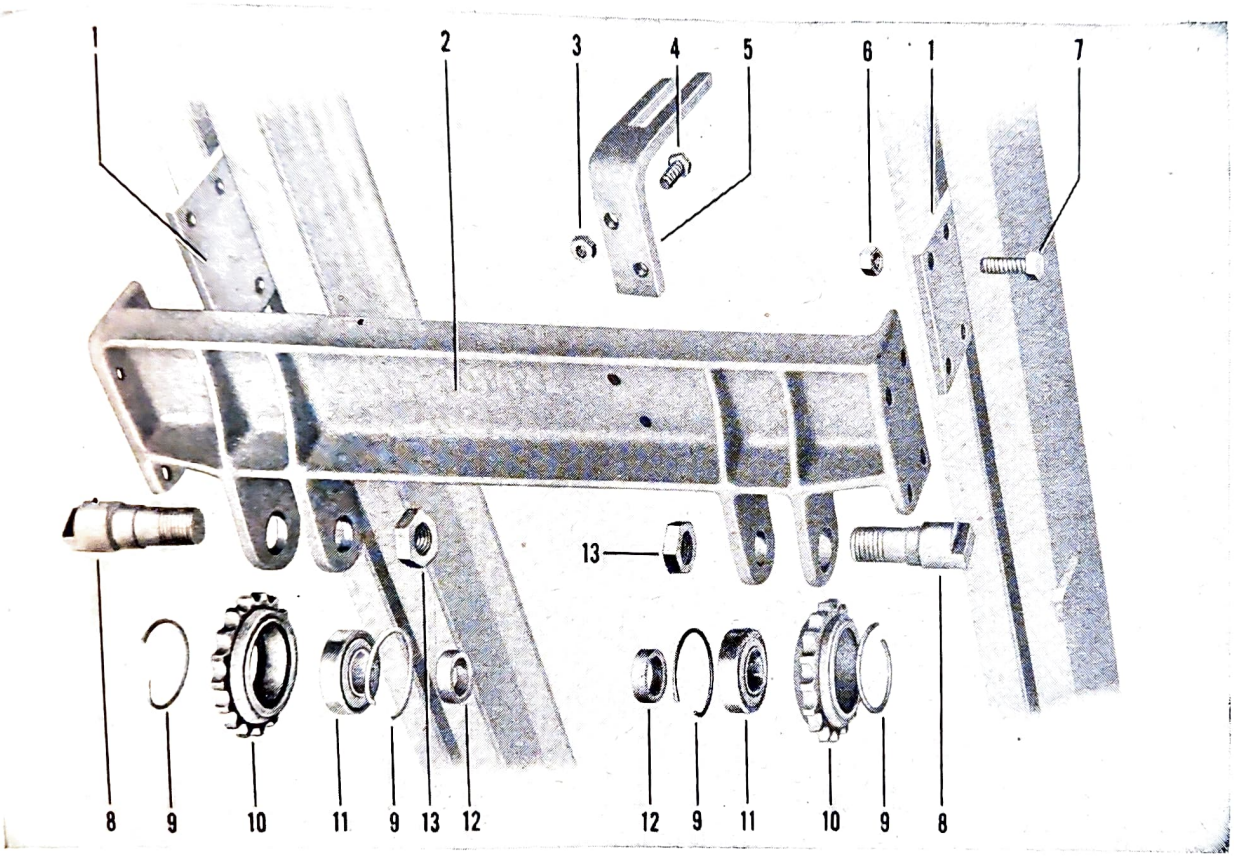
c. Install Drive Wheels. See paragraph 69.

d. Adjust. Perform all lift adjustments. (See par. 78.)



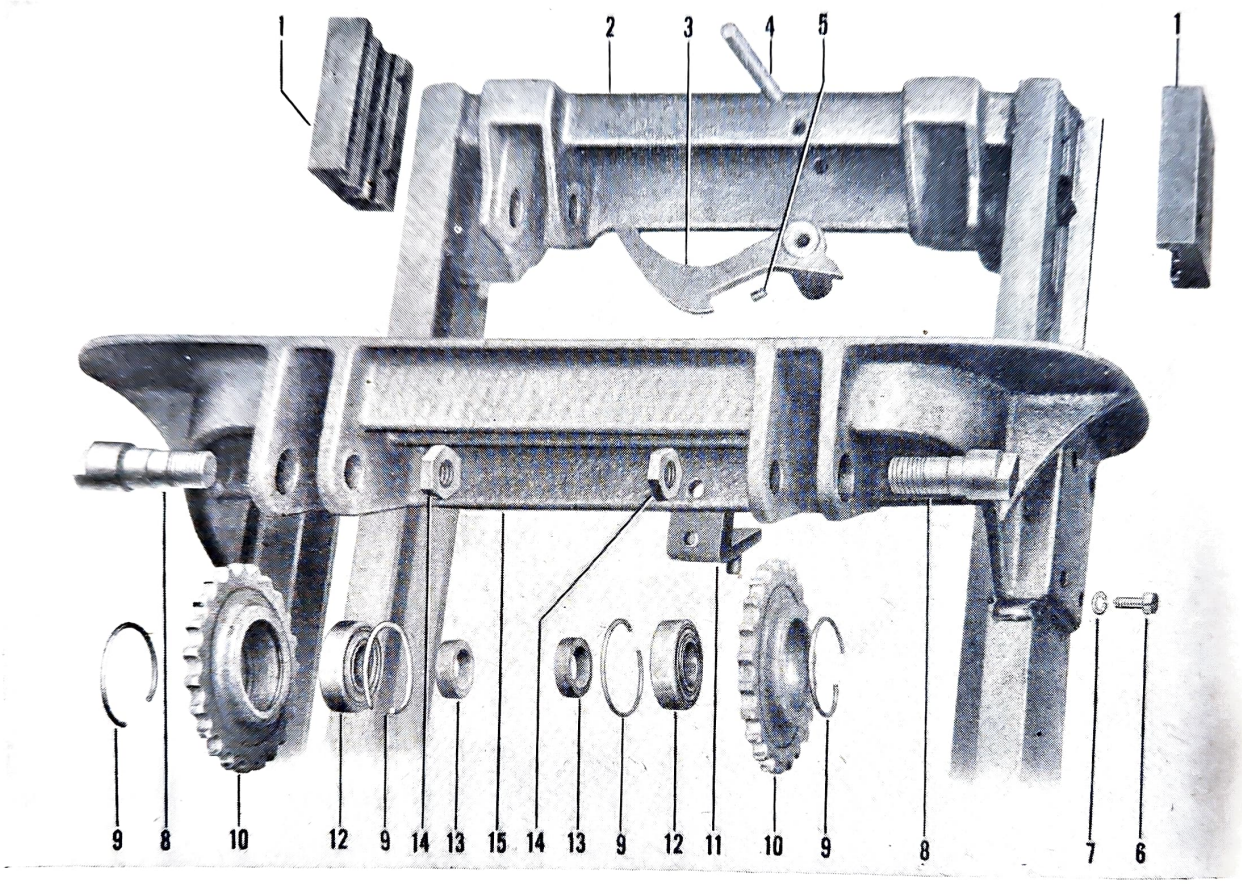
1. *Carriage back rest guide.*
2. *Carriage left shoe.*
3. *Carriage idler sprocket lubrication fitting.*
4. *Carriage idler sprocket shaft nut.*
5. *Carriage shoe pin.*
6. *Lift chain adjusting bolt nut.*
7. *Lift chain adjusting bolt.*
8. *Carriage idler sprocket shaft.*
9. *Carriage stop pin.*
10. *Carriage stop pin collar.*
11. *Carriage idler sprocket.*
12. *Carriage right shoe.*
13. *Carriage right bracket.*
14. *Carriage stop pin nut.*
15. *Carriage idler sprocket bushing.*
16. *Carriage left bracket.*

Figure 132. Carriage and lift sprockets.



1. *Lower bracket.*
2. *Lift sprocket supporting beam (lower) for inner mast.*
3. *Cap screw nut.*
4. *Cap screw.*
5. *Stop bracket.*
6. *Cap screw nut.*
7. *Cap screw.*
8. *Lift sprocket shaft.*
9. *Lift sprocket ball bearing snap ring.*
10. *Lift sprocket.*
11. *Lift sprocket ball bearing.*
12. *Lift sprocket spacer.*
13. *Lift sprocket nut.*

Figure 133. Lift sprockets on lift sprocket supporting beam.



1. *Outer mast guide shoe.*
2. *Lift sprocket supporting beam (upper) for inner mast.*
3. *Inner mast hook.*
4. *Inner mast hook pin.*
5. *Inner mast hook set screw.*
6. *Outer mast guide shoe cap screw.*
7. *Outer mast guide shoe cap screw lockwasher.*
8. *Lift sprocket shaft.*
9. *Lift sprocket ball bearing snap ring.*
10. *Outer mast lift sprocket.*
11. *Outer mast stop bracket.*
12. *Lift sprocket ball bearing.*
13. *Lift sprocket spacer.*
14. *Lift sprocket nut.*
15. *Lift sprocket supporting beam for outer mast.*

Figure 134. Lift sprockets and bearings at top of mast.

Section XVI. LIFT MECHANISM

162. General

a. The lift mechanism consists of the lift control lever with the linkage which connects the lever to the lift clutches; the engine power is transmitted through the clutches to the gearcase gears and from the gearcase to the lift chains through drive sprockets at the gearcase.

b. Clutch repair is covered in paragraph 152; the repair of the drive axle housing is covered in paragraph 208. Repair of mast assembly which carries the lift chains to the carriage is covered in paragraph 165. This section covers the lift rod guide bracket assembly.

163. Removal of Lift Rod Guide Bracket

See paragraph 151.

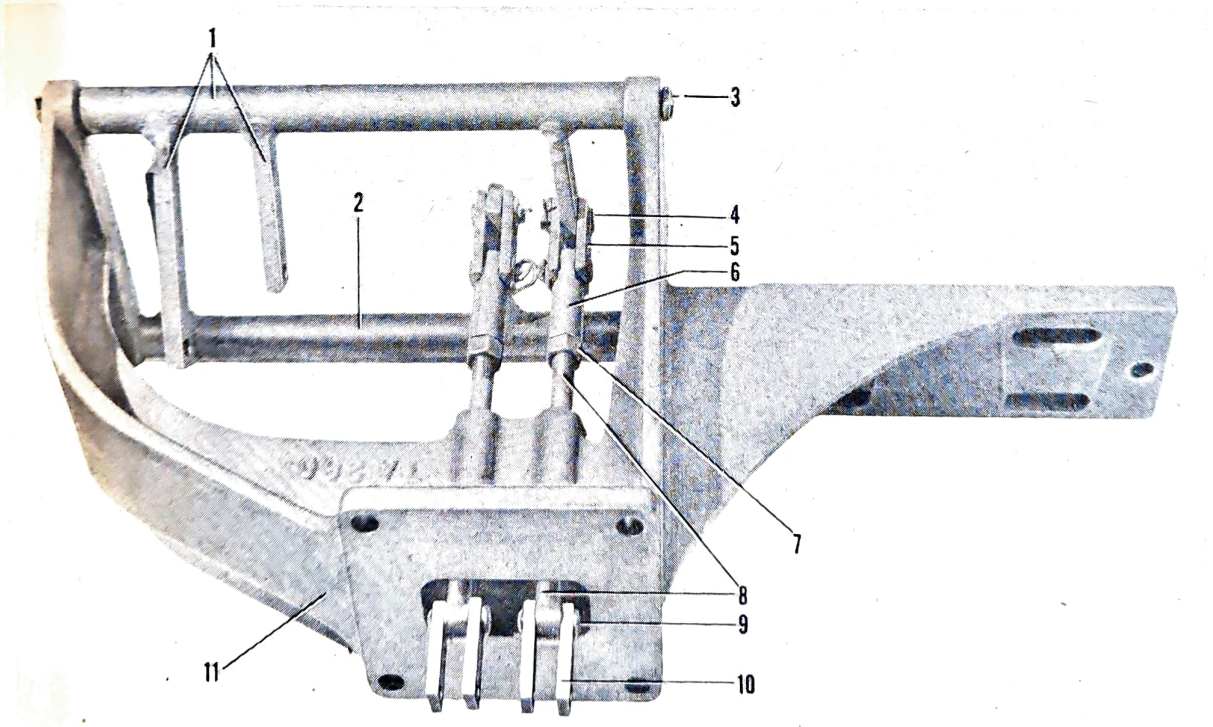
164. Disassembly of Lift Rod Guide Bracket

a. Separate Lift Rod Guide Bracket Assembly From Intermediate Bearing Housing Assembly. Remove four carriage bolts which secure intermediate bearing housing unit to lift rod guide bracket unit. This separates the two units.

b. Disassemble Intermediate Bearing Housing Assembly. The intermediate bearing housing unit is a part of the tilt mechanism and is covered in section XVII, chapter 5.

c. Disassembly of Lift Rod Guide Bracket (fig. 135). (1) Remove cotter and clevis pins from clutch lift rod links and remove links from clutch lift rod nuts and bell cranks. Loosen clutch lift rod lock nuts and unscrew clutch lift rod nuts from clutch lift rods.

(2) Remove cotter and clevis pins from lift links and remove clutch lift rods from lift rod guide bracket. Remove cotter pins from control bell crank pin and remove control bell crank pin from lift rod guide bracket.



1. *Lift control bell crank.*
2. *Motion control bell crank.*
3. *Control bell crank pin.*
4. *Link clevis pin.*
5. *Clutch lift rod link.*
6. *Clutch lift rod nut.*
7. *Clutch lift rod lock nut.*
8. *Clutch lift rod.*
9. *Link clevis pin.*
10. *Lift link.*
11. *Lift rod guide bracket.*

Figure 135. Lift rod guide bracket assembly.

165. Inspection and Repair of Lift Rod Guide Bracket

Inspect all threads for damage, crossed, or burred threads; if necessary, straighten threads with a thread die. See that bell cranks and bracket are in good condition with no fractures or cracks.

166. Assembly of Lift Rod Guide Bracket

a. Assemble Lift Rod Guide Bracket (fig. 135). (1) Push control bell crank pin into lift rod guide bracket and secure with cotter pins. Install clutch lift rods in lift rod guide bracket and then install lift links on clutch lift rods. Secure links to rod with clevis and cotter pins.

(2) Install clutch lift rod lock nuts on clutch lift rods and then install clutch lift rod nuts on rods. Do not tighten lock nuts until after assembly is installed in vehicle; these nuts are used to adjust the clutch shifting collar in neutral when the lever is in neutral.

(3) Install clutch lift rod links and secure to the clutch lift rod nuts and bell cranks with clevis and cotter pins.

b. Assemble Intermediate Bearing Housing Assembly. The intermediate bearing housing assembly is a part of the tilt mechanism and is covered in section XVII, chapter 5.

c. Assemble Lift Rod Guide Bracket and Intermediate Bearing Housing Assemblies. Assemble the two units and secure with four carriage bolts.

167. Installation

See paragraph 155 for installation.

Section XVII. TILT MECHANISM

168. General

The tilt mechanism consists of the power take-off unit which receives engine power from a sprocket on the clutch main drive shaft. Power is transmitted through a drive belt to an intermediate bearing housing unit, and then through a tilt worm housing unit to operate the tilt pinion and racks. This section covers the tilt mechanism.

169. Removal

a. Remove Power Take-Off Unit. See paragraph 81.

b. Remove Intermediate Bearing Housing Unit. See paragraph 81.

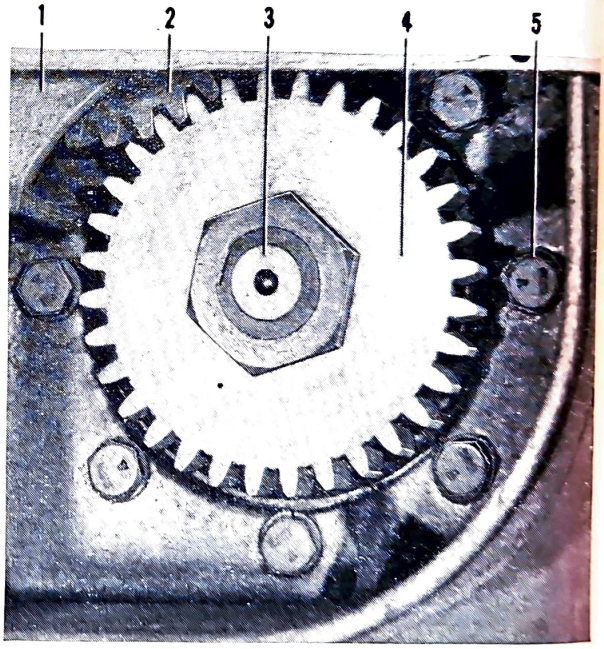
c. Remove Tilt Worm Housing Assembly (fig. 136). (1) Remove tilt worm housing drain plug and drain lubricant.

(2) Remove six cap screws which secure tilt worm housing to tilt shaft bracket (left side). Hold or block tilt worm housing to prevent it from falling. Remove tilt worm housing assembly.

d. Remove Tilt Shaft Brackets and Tilt Pinion. (fig. 137). (1) Remove cap screws which secure rack guide brackets to rack guide and remove rack guide.

(2) Remove four bolts, nuts, and lockwashers which secure tilt shaft bracket (right and left) to angle side frames and remove brackets with tilt pinion.

e. Remove Tilt Racks. See paragraph 158.

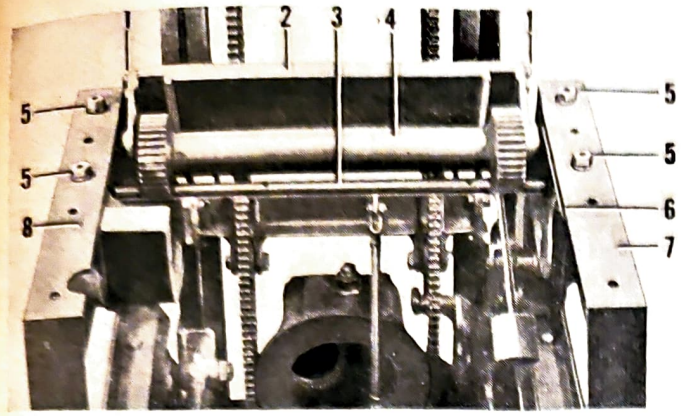


1. *Tilt worm housing.*
2. *Tilt pinion.*
3. *Worm wheel shaft.*
4. *Intermediate tilt gear.*
5. *Cap screw.*

Figure 136. Tilt worm housing installed.

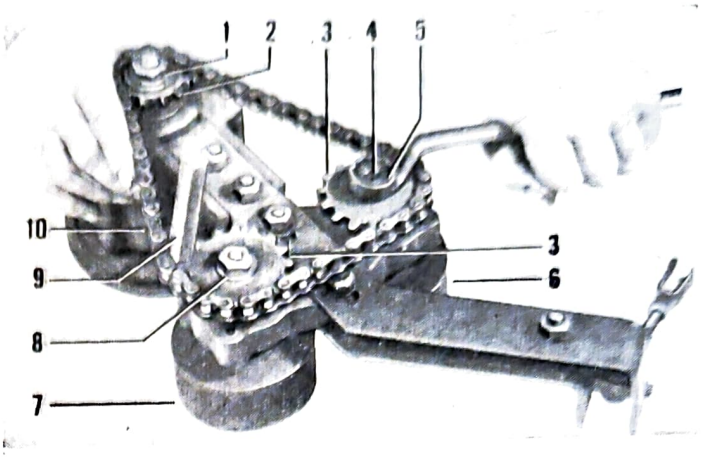
170. Disassembly of Intermediate Bearing Housing Unit

a. Remove Power Tilt Drive Chain (figs. 138 and 139). (1) Block power tilt drive chain from turning by placing a block between a sprocket and the chain. (See fig. 138.) Remove the three nuts



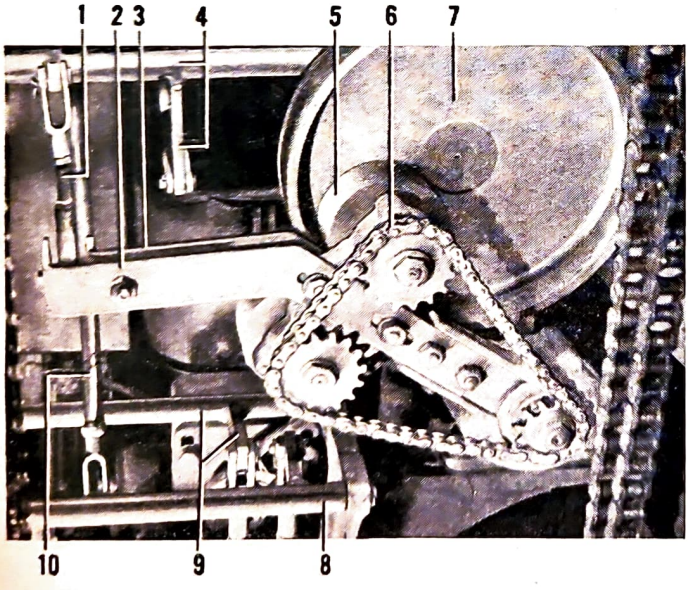
1. *Cap screw.*
2. *Rack guide.*
3. *Tilt control bell crank.*
4. *Tilt pinion.*
5. *Bolts, nuts, and lockwashers.*
6. *Rack guide bracket.*
7. *Angle side frame—right.*
8. *Angle side frame—left.*

Figure 137. *Tilt pinion in vehicle.*



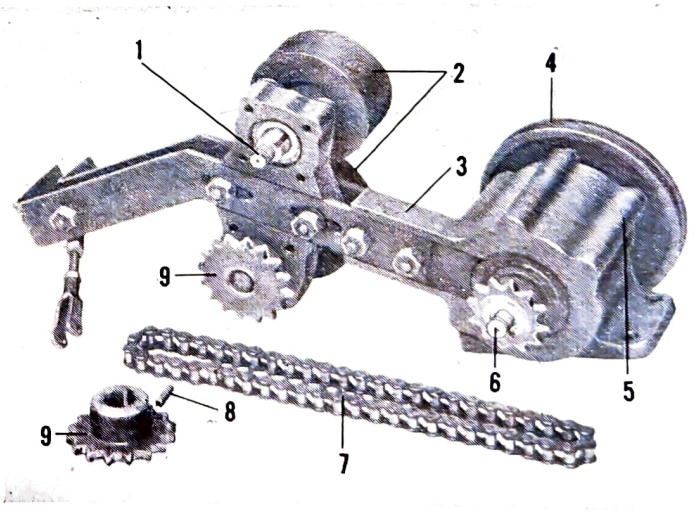
1. *Friction wheel shaft nut.*
2. *Friction wheel drive sprocket.*
3. *Friction wheel sprockets.*
4. *Friction wheel shaft.*
5. *Friction wheel shaft nut.*
6. *Friction wheel.*
7. *Friction wheel.*
8. *Friction wheel shaft nut.*
9. *Wood block.*
10. *Power tilt drive chain.*

Figure 139. *Removing friction wheel sprocket and friction wheel drive sprocket.*



1. *Tilt control bracket rod.*
2. *Tilt control bracket (long).*
3. *Tilt control bracket (short).*
4. *Tilt control bell crank.*
5. *Friction wheel.*
6. *Power tilt drive chain.*
7. *Friction drum.*
8. *Lift control bell crank.*
9. *Motion control bell crank.*
10. *Lift control rod.*

Figure 138. Tilt controls with friction wheel and drum.



1. *Friction wheel shaft.*
2. *Friction wheels.*
3. *Friction drive bracket.*
4. *Intermediate pulley.*
5. *Friction drive bracket.*
6. *Intermediate pulley shaft.*
7. *Power tilt drive chain.*
8. *Key.*
9. *Friction wheel sprockets.*

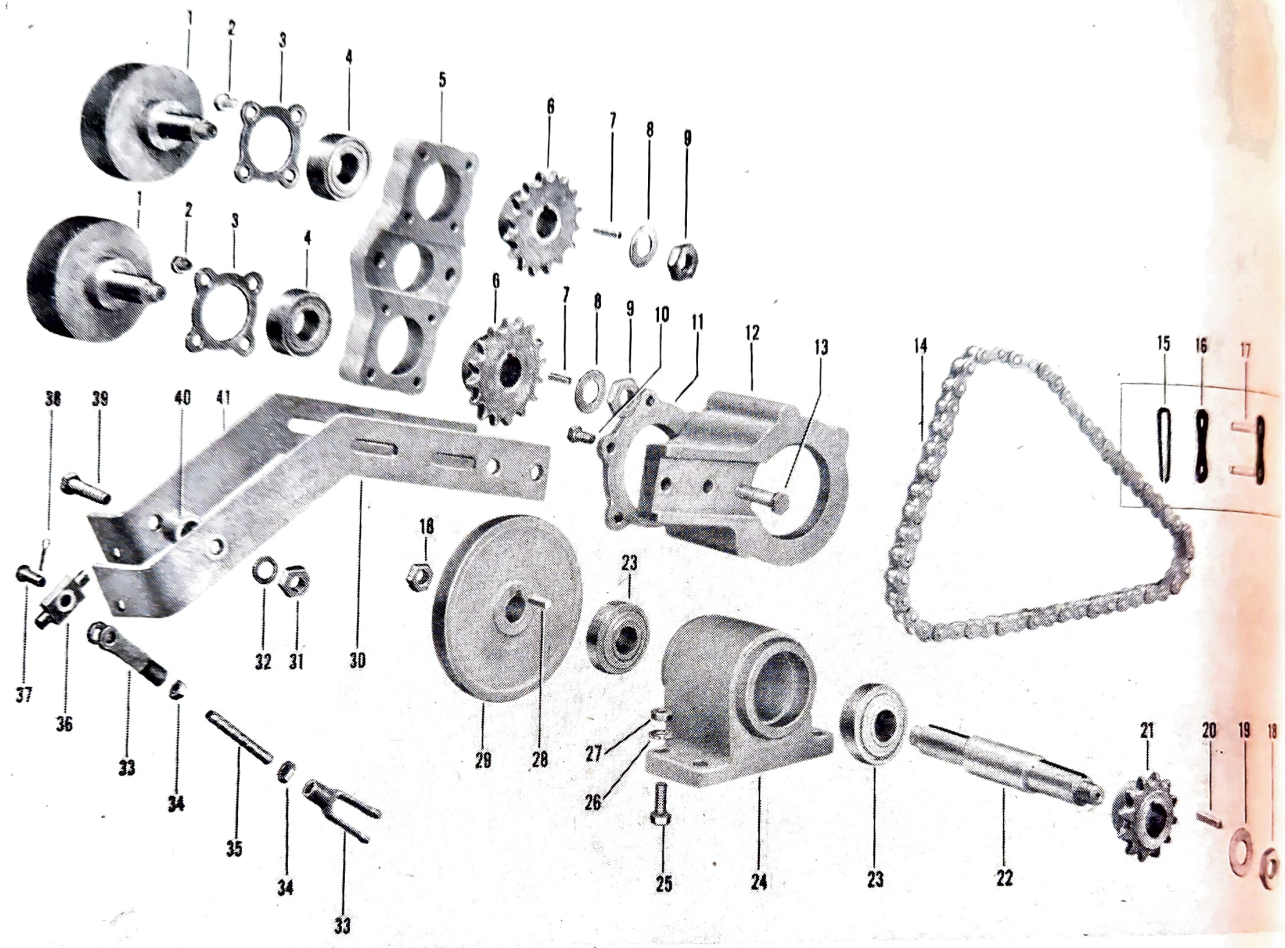
Figure 140. *Friction wheel sprocket and power tilt drive chain removed.*

which secure the two friction wheel sprockets and the friction wheel drive sprocket on their shafts.

(2) Drive friction wheel sprocket off one friction wheel shaft by driving on end of shaft. When the sprocket is off its shaft the power tilt drive chain can be removed.

b. Remove Friction Wheels (fig. 140). (1) Drive remaining friction wheel sprocket off the other friction wheel shaft and remove sprocket key from shaft.

(2) Drive the two friction wheels off the friction wheel shafts.



1. *Friction wheel with shaft assembly.*
2. *Retainer screw.*
3. *Ball bearing retainer.*
4. *Ball bearing.*
5. *Friction wheel ball bearing support.*
6. *Friction wheel sprocket.*
7. *Flat key.*
8. *Plain washer.*
9. *Friction wheel shaft nut.*
10. *Friction drive bracket cover cap screw.*
11. *Friction drive bracket cover.*
12. *Friction drive bracket.*
13. *Friction drive bracket cap screw.*
14. *Drive chain assembly.*
15. *Drive chain connecting link lock.*
16. *Drive chain connecting link plate.*
17. *Drive chain connecting link with pins assembly.*
18. *Intermediate pulley shaft nut.*
19. *Plain washer.*
20. *Flat key.*
21. *Friction wheel drive sprocket.*
22. *Intermediate pulley shaft.*
23. *Intermediate pulley shaft ball bearing.*
24. *Intermediate pulley shaft ball bearing housing.*
25. *Cap screw.*
26. *Lockwasher.*
27. *Nut.*
28. *Flat key.*
29. *Intermediate pulley.*
30. *Tilt control long bracket.*
31. *Bracket bolt nut.*
32. *Lockwasher.*
33. *Bracket rod yoke.*
34. *Nut.*
35. *Bracket rod.*
36. *Tilt control clevis block.*
37. *Clevis pin.*
38. *Cotter pin.*
39. *Bracket cap screw.*
40. *Bracket spacer.*
41. *Tilt control short bracket.*

Figure 141. Tilt sheave bracket, bearing housing, bearings, and friction wheels.

c. Disassemble Intermediate Pulley Shaft Assembly (fig. 140). (1) Drive intermediate pulley shaft assembly out of intermediate bearing housing. Remove nut which secures intermediate pulley on shaft.

(2) Press intermediate pulley off shaft and remove key from shaft. Press intermediate pulley bearings off shaft.

d. Remove Friction Wheel Bearings (fig. 141). (1) Remove cap screws which secure friction drive bracket cover to drive bracket. Remove friction drive bracket cover and remove intermediate bearing housing from drive bracket.

(2) Remove cap screws which secure the friction wheel bearing retainers to the friction wheel bearing support. Drive friction wheel bearings out of retainers.

e. Remove Friction Drive Bracket (fig. 141). Remove two bolts, nuts, and lockwashers which secure friction drive bracket to tilt control brackets. Remove friction drive bracket.

f. Remove Friction Wheel Bearing Support (fig. 141). Remove two bolts, nuts, and lockwashers which secure friction wheel bearing support to tilt control brackets. Remove friction wheel bearing support.

g. Disassemble Tilt Control Brackets (fig. 141). (1) Remove bolt, nut, washer, and tilt control bracket spacer which secure tilt control short bracket to tilt control long bracket. This separates the two brackets.

(2) Remove cotter pin, clevis pin, and tilt control clevis block from clevis of tilt control bracket rod. Loosen nuts on tilt control bracket rod and remove clevis from each end.

171. Inspection and Repair of Intermediate Bearing Housing

Clean all parts except the friction wheels in solvent, dry cleaning. Inspect power tilt drive chain for wear or breaks; replace links in bad condition with master links. Inspect sprockets for chips, breaks, scores, or damage. Inspect keys and keyways for chipped or burred edges. Rotate ball bearings with the fingers and inspect for rough or noisy action. ***Caution:*** Do not spin ball bearings with compressed air. See that all threads are in good condition with no burred or cross threads. Straighten threads with a thread die if necessary.

172. Assembly of Intermediate Bearing Housing

a. Assemble Tilt Control Brackets (fig. 141). (1) Install nut and clevis on each end of tilt control bracket rod; do not tighten locknuts until after final assembly because adjustments of the tilt control rods must be made at that time. Install tilt control clevis block and tilt control bracket rod on tilt control bracket and secure rod to bracket with clevis and cotter pin.

(2) Assemble tilt control long bracket to short bracket with bracket spacer and secure with bolt, nut and washer.

b. Install Friction Wheel Bearing Support (fig. 141). Install friction wheel bearing support on tilt control brackets and secure with two bolts, nuts, and lockwashers.

c. Install Friction Drive Bracket (fig. 141). Install friction drive bracket on tilt control brackets and secure with two bolts, nuts, and lockwashers.

d. Install Friction Wheel Bearings (fig. 141). (1) Install friction wheel bearings in retainers and assemble to friction wheel bearing support with cap screws.

(2) Install intermediate bearing housing in friction drive bracket. Install friction drive bracket cover on drive bracket and secure with cap screws.

e. Assemble Intermediate Pulley Shaft Assembly (fig. 141). (1) Press intermediate pulley bearings on intermediate pulley shaft. Install key in shaft keyway and then press pulley on shaft and key.

(2) Install nut which secures intermediate pulley on shaft. Press intermediate pulley shaft assembly into intermediate bearing housing.

f. Install Friction Wheels (fig. 141). Press the two friction wheels on friction wheel shafts. Install friction wheel sprocket key in friction wheel shaft keyway, and press sprocket on shaft and key.

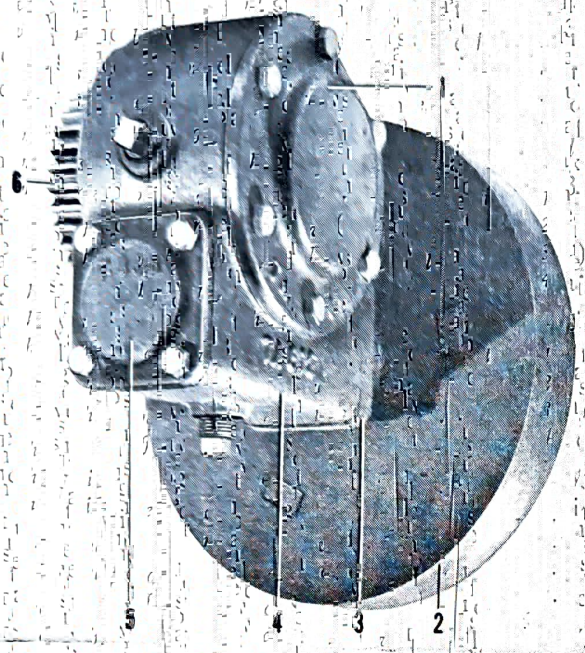
g. Install Power Tilt Drive Chain (fig. 141). (1) Place power tilt drive chain on friction wheel sprocket and press friction wheel sprocket on friction wheel shaft.

(2) Install the three nuts which secure the two friction wheel sprockets and the friction wheel drive sprocket on their shafts.

173. Disassembly of Tilt Worm Housing Unit

a. Remove Grease Seal Retainer (figs. 142 and 143). Remove nut which secures intermediate tilt gear to worm wheel shaft. Press friction drum

off worm shaft and remove friction drum key from worm shaft. Remove cap screws which secure grease seal retainer to tilt worm housing and remove grease seal retainer and gasket. Press grease seal out of grease seal retainer.



1. *Tilt worm housing cover.*
2. *Friction drum.*
3. *Grease seal retainer.*
4. *Tilt worm housing.*
5. *Worm thrust cover.*
6. *Intermediate tilt gear.*
7. *Power tilt drive chain.*

Figure 142. Tilt worm housing assembly.

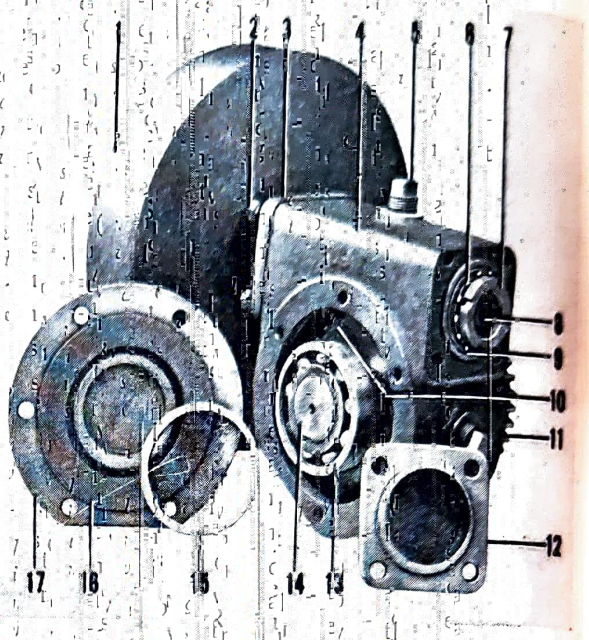
b. Remove Worm and Shaft (figs. 143 and 144). Remove cap screws which secure worm thrust cover to tilt worm housing and remove worm thrust cover and gasket. Remove worm bearing locknut and worm bearing lockwasher. Press worm and shaft out of tilt worm housing. The front worm ball bearing will be pressed off with the shaft.

c. Remove Worm Ball Bearings (figs. 144-145). Press worm ball bearing off worm shaft. Press worm thrust bearing out of worm housing.

d. Remove Worm Wheel Shaft Bearing. (1) Remove cap screws which secure tilt worm housing cover to tilt worm housing and remove cover and gasket. Remove bearing spacer from tilt pinion bearing. (See fig. 143.)

(2) Press intermediate tilt gear off worm wheel shaft. Remove worm wheel shaft (with worm wheel and the two worm wheel shaft bearings still on the shaft) from tilt worm housing. Remove intermediate tilt gear key from worm wheel shaft.

(3) Press worm wheel and bearing off worm wheel shaft in one pressing operation. (See fig. 144.) Press remaining bearing off worm wheel shaft. Remove worm wheel key from worm wheel shaft.



1. *Friction drum.*
2. *Grease seal retainer cap screw.*
3. *Grease seal retainer.*
4. *Tilt worm housing.*
5. *Tilt worm housing drain plug.*
6. *Worm bearing lockwasher.*
7. *Worm bearing lock nut.*
8. *Worm.*
9. *Worm thrust bearing.*
10. *Worm wheel.*
11. *Intermediate tilt gear.*
12. *Worm thrust cover.*
13. *Worm wheel shaft bearing.*
14. *Worm wheel shaft.*
15. *Bearing spacer.*
16. *Tilt worm bearing cover.*
17. *Tilt worm housing cover gasket.*

Figure 143. Tilt worm housing—covers removed.

174. Inspection and Repair of Tilt Worm Housing Unit

After cleaning, inspect all gear teeth for pits, cracks, chips, or breaks. Replace all gaskets. Clean ball bearings in solvent, dry cleaning, and dry thoroughly. **Caution:** Do not spin ball bearings with compressed air. Rotate bearing and observe for rough operation and noise.

175. Assembly of Tilt Worm Housing Unit

a. Install Worm Wheel Shaft Bearings (fig. 146). (1) Press worm wheel shaft bearing on worm wheel shaft; be sure that bearing rests

176. Disassembly of Power Take-off Bracket

a. Remove Power Take-Off Housing and Chain. See paragraph 77*h*.

b. Remove Power Take-off Shaft (fig. 147). Remove shaft nut with lockwasher which secures sprocket on shaft and remove sprocket from shaft. Remove sprocket key from shaft. Drive shaft out of bracket.

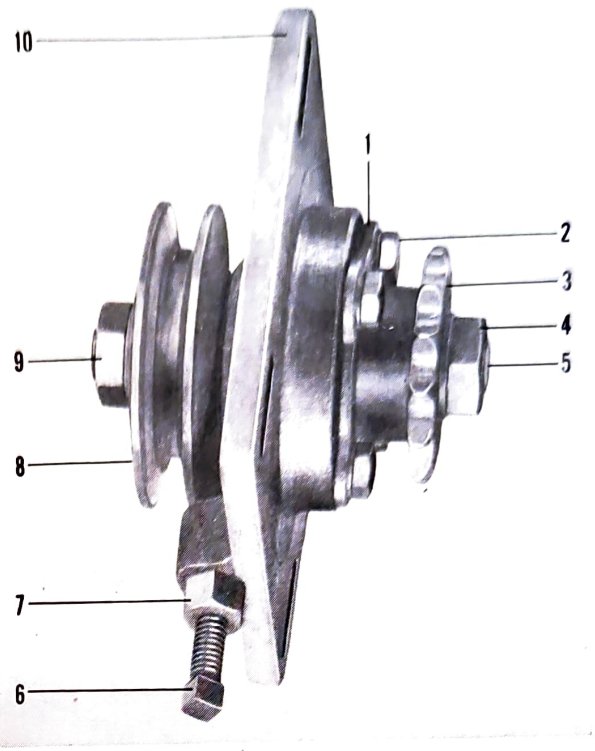
c. Remove Power Take-Off Bearing (fig. 148). Remove cap screws and lockwashers and remove bearing cover from bracket. Drive bearing out of bracket and remove oil seal from bracket.

d. Dissassemble Power Take-Off Shaft (fig. 148). Remove shaft nut, and lockwasher which secure tilt drive pulley to shaft. Press tilt drive pulley from shaft and remove key from the shaft.

e. Remove Power Take-Off Chain Adjusting Screw (fig. 148). Loosen chain adjusting screw lock nut and screw chain adjusting screw from power take-off bracket.

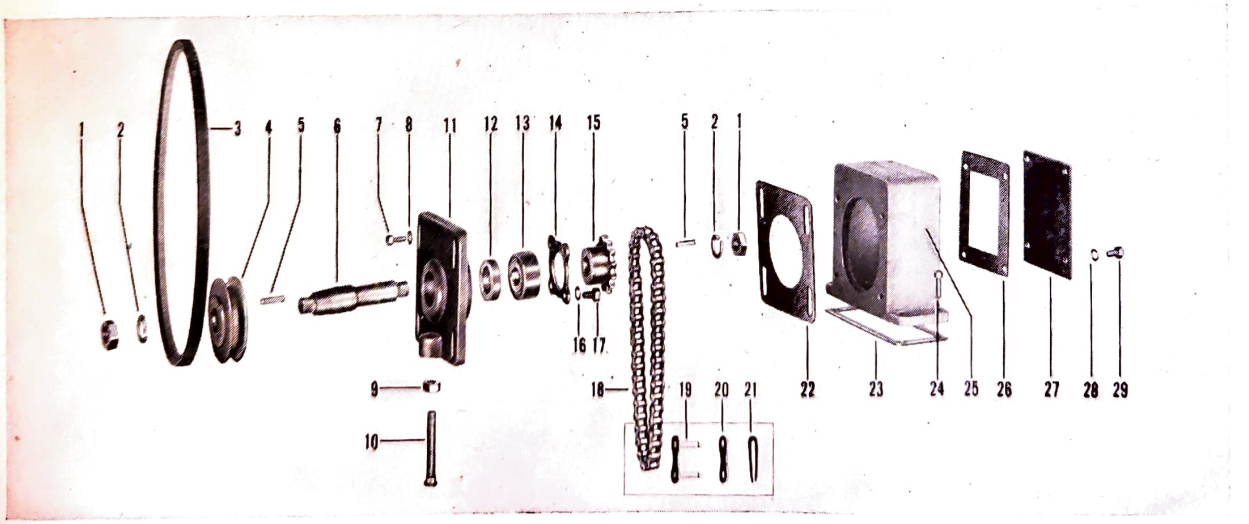
177. Inspection and Repair of Power Take-off Bracket

Inspect all threads for damage; if necessary, use a thread die to straighten up mashed or cross threads. After cleaning, inspect gear teeth for pits, cracks, chips, or breaks. Inspect keys and keyways for chipped or burred edges. Replace damaged parts.



1. *Bearing cover.*
2. *Cap screw.*
3. *Sprocket.*
4. *Shaft nut.*
5. *Shaft.*
6. *Chain adjusting screw.*
7. *Screw lock nut.*
8. *Tilt drive pulley.*
9. *Shaft nut.*
10. *Bracket.*

Figure 147. Power take-off bracket assembly.



1. *Shaft nut.*
2. *Lockwasher.*
3. *Tilt drive "V" belt.*
4. *Tilt drive pulley.*
5. *Flat key.*
6. *Shaft.*
7. *Bracket cap screw.*
8. *Plain washer.*
9. *Screw lock nut.*
10. *Chain adjusting screw.*
11. *Bracket.*
12. *Oil seal.*
13. *Ball bearing.*
14. *Bearing cover.*
15. *Driven sprocket.*
16. *Lockwasher.*
17. *Bearing cover cap screw.*
18. *Chain assembly.*
19. *Connecting link with pins assembly.*
20. *Connecting link side plate.*
21. *Connecting link lock.*
22. *Bracket to housing gasket.*
23. *Housing to clutch case gasket.*
24. *Housing cap screw.*
25. *Housing.*
26. *Inspection cover to housing gasket*
27. *Inspection cover.*
28. *Lockwasher.*
29. *Inspection cover cap screw.*

Figure 148. Power take-off assembly.

178. Assembly of Power Take-off Bracket

a. Install Power Take-Off Chain Adjusting Screw (fig. 148). (1) Install chain adjusting screw in power take-off bracket and tighten chain adjusting screw nut.

(2) Adjust power take-off chain after power take-off assembly is installed.

b. Assemble Power Take-Off Shaft (fig. 148). Install key in shaft and press tilt drive pulley on power take-off shaft and key. Secure pulley on shaft with shaft nut and lockwasher.

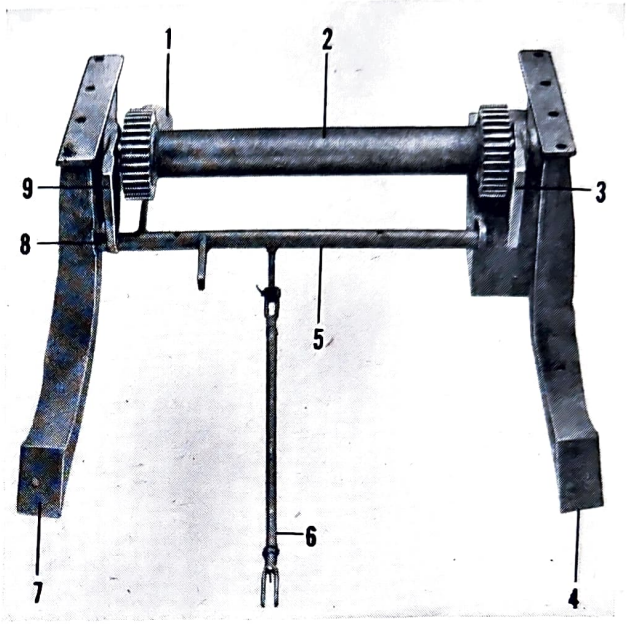
c. Install Power Take-Off Bearing (fig. 148). Install new power take-off oil seal in bracket and press bearing into bracket. Install bearing cover on bracket and secure with cap screws and lockwashers.

d. Install Power Take-Off Shaft (fig. 148). Press power take-off shaft into bearing in the bracket. Install sprocket key in keyway on shaft and press sprocket on shaft and key. Install shaft nut with lockwasher which secures sprocket to shaft.

e. Install Drive Belt, Power Take-Off Chain and Housing. See paragraph 81*b*.

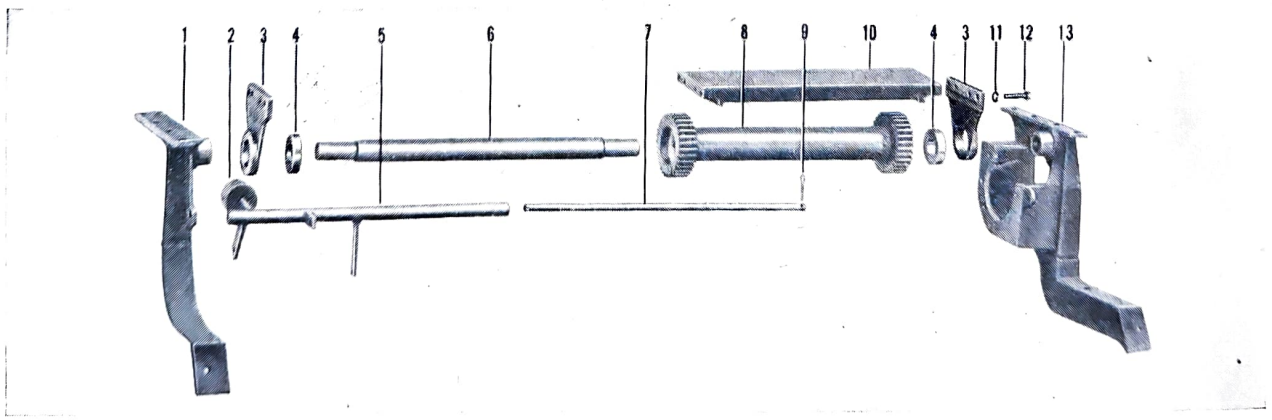
179. Disassembly of Tilt Pinion (figs. 149 and 150)

Remove cotter and clevis pins which secure tilt control upper rod to tilt control bell crank and remove tilt control upper rod. Remove set screw and tilt control counterweight from tilt control bell crank. Remove cotter pins at the end of the tilt control bell crank shaft and remove tilt control bell crank shaft from tilt control bell crank. Remove tilt control bell crank. Remove tilt pinion assembly. Remove one tilt shaft bracket with rack spacer bracket. Remove tilt pinion bearings from ends of tilt pinion and remove tilt pinion from shaft. Remove tilt



1. *Tilt control counterweight.*
2. *Tilt pinion.*
3. *Rack spacer bracket.*
4. *Tilt shaft bracket, left.*
5. *Tilt control bell crank.*
6. *Tilt control rod—upper.*
7. *Tilt shaft bracket—right.*
8. *Tilt control bell crank shaft.*
9. *Rack spacer bracket.*

Figure 149. Tilt pinion with brackets.



1. *Tilt shaft bracket—right.*
2. *Tilt control counterweight.*
3. *Rack spacer bracket.*
4. *Tilt pinion ball bearing.*
5. *Tilt control bell crank.*
6. *Tilt pinion shaft.*
7. *Tilt control bell crank shaft.*
8. *Tilt pinion.*
9. *Cotter pin.*
10. *Rack spacer.*
11. *Lockwasher.*
12. *Cap screw.*
13. *Tilt shaft bracket—left.*

Figure 150. Tilt pinion.

shaft brackets (right and left) from rack spacer brackets.

180. Inspection and Repair of Tilt Pinion

Clean bearings in solvent, dry cleaning, and test for smooth action by rotating them by hand. **Caution:** Do not spin bearings with compressed air. After cleaning, inspect gear teeth for pits, cracks, chips, or breaks. See that castings are free of cracks. Replace damaged parts.

181. Assembly of Tilt Pinion

Install tilt pinion on tilt pinion shaft. Assemble rack spacer brackets to tilt shaft brackets (right and left). Place tilt pinion bearings in ends of tilt pinion. Install tilt pinion assembly in rack spacer brackets and tilt shaft brackets. Install tilt control bell crank between tilt shaft brackets (right and left) and insert tilt control bell crank shaft through tilt control bell crank. Secure ends of tilt control bell crank shaft with cotter pins. Install set screw and tilt control counterweight on tilt control bell crank. Install tilt control upper rod on tilt control bell crank and secure with clevis and cotter pins.

182. Installation

a. Install Tilt Racks. See paragraph 160.

b. Install Tilt Shaft Brackets and Tilt Pinion (fig. 137). (1) Install tilt pinion with brackets on angle side frames. Secure the right and left tilt shaft brackets to the angle side frames with four bolts, nuts, and lockwashers.

(2) Install rack spacer on rack spacer brackets and secure with cap screws.

c. Install Tilt Worm Housing (fig. 136). (1) Install tilt worm housing and secure to tilt shaft bracket with six cap screws.

(2) Install tilt worm housing drain plug and fill with lubricant in accordance with instructions on War Department Lubrication Order.

d. Install Intermediate Bearing Housing Unit. See paragraph 182.

e. Install Power Take-Off Unit. See paragraph 81.

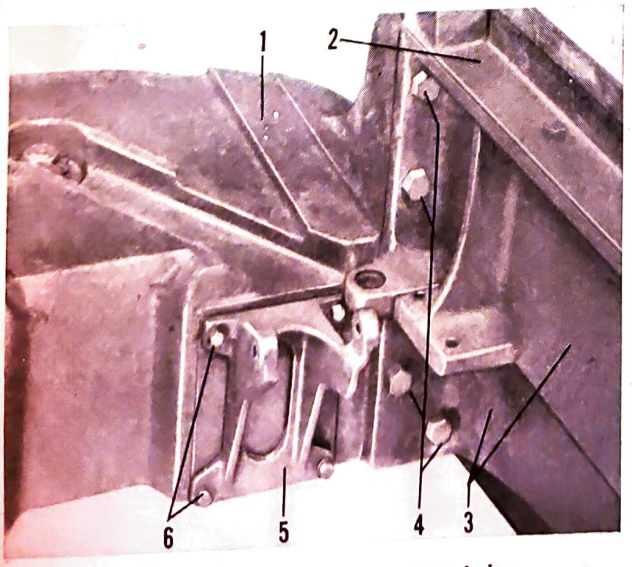
Section XVIII. BRAKES

183. General

Adjustable, internal, expanding brakes are used on the drive wheels. The brake bands, operated by the brake pedal, expand into drums which are a part of the wheel.

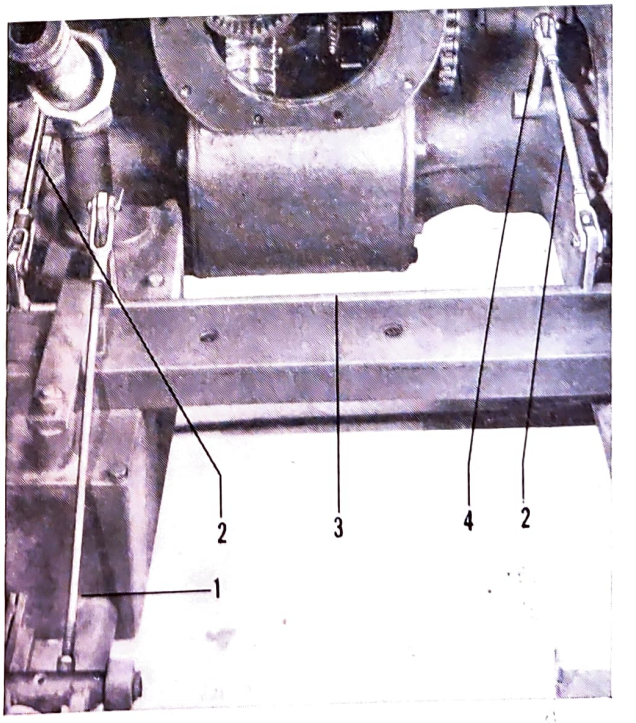
184. Removal

a. Remove Brake Pedal (fig. 152.) Remove cotter pins securing brake pedal pin and remove pin from brake pedal and brake pedal bracket. Remove cotter and clevis pins which secure brake pedal connecting rod to brake pedal and disconnect rod from pedal. Lift brake pedal off vehicle.



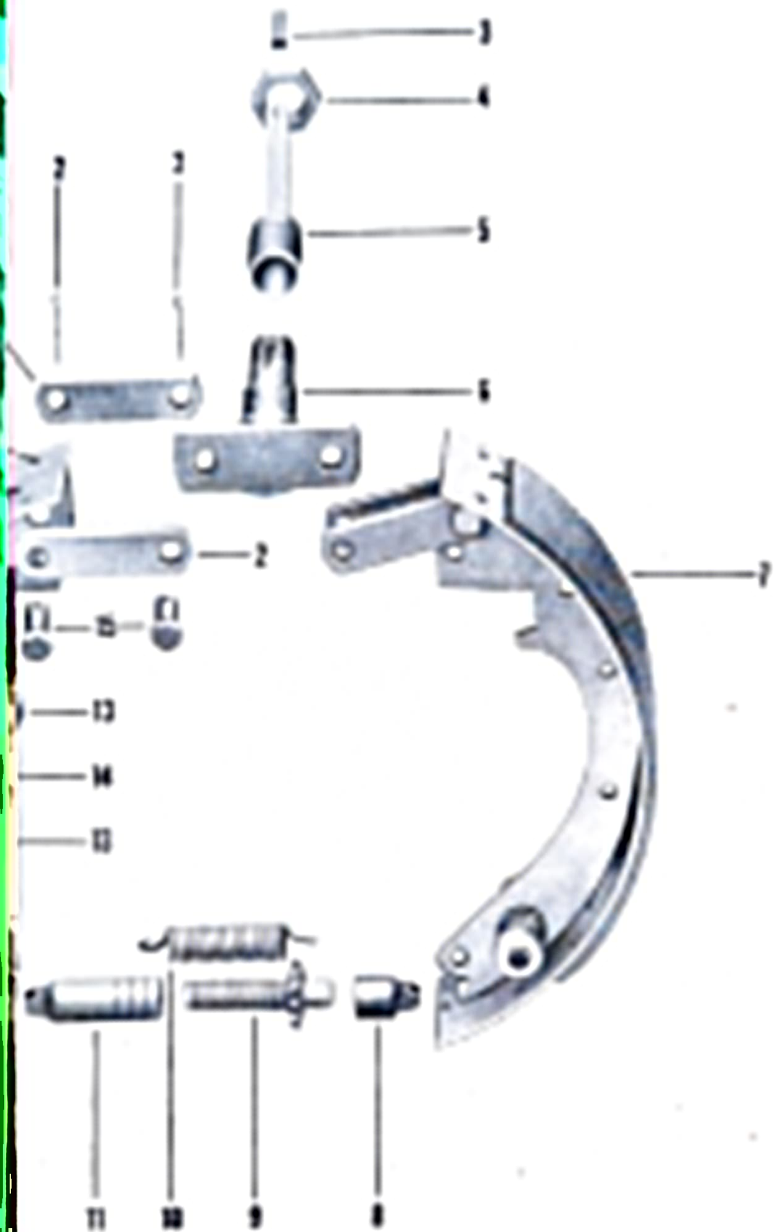
1. Rear counterweight.
2. Frame channel, left.
3. Counterweight, right.
4. Counterweight bolts.
5. Brake pedal bracket.
6. Brake pedal bracket cap screw.

Figure 151. Brake pedal bracket.



1. Brake pedal rod.
2. Brake lever rod.
3. Brake bell crank.
4. Brake lever and sleeve.

Figure 152. Brake control rods installed.



10. Retracting spring.
11. Brake shoe adjusting device (female thread).
12. Brake shoe anchor pin.
13. Anchor pin spring retainer.
14. Brake shoe retracting spring.
15. Brake link clevis pins.
16. Brake shoe lining.
17. Brake shoe lining rivet.
18. Brake shoe.

Figure 153. Brake assembly.